Coso Monitoring Program
October 1999 Through September 2000

by
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NAVAL AIR WEAPONS STATION
CHINA LAKE, CA 93555-6100

FOREWORD

This report presents the status of the Coso Monitoring Program conducted for the period October 1999 through September 2000 by the Naval Air Weapons Station (NAWS), China Lake, Calif. The investigation, funded under the NAWS Coso Geothermal Development Program, is being conducted to provide baseline information on hydrology and surface geothermal activity in the Coso Hot Springs area.

This report was reviewed for technical accuracy by Steven C. Bjornstad and Allan M. Katzenstein (NAWS 83G000D).

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(U) The Coso Monitoring Program is a continuing effort in support of the Navy's geothermal resources within the Coso Known Geothermal Resource Area (Coso KGRA). A substantial body of reports has been established on this project (17 technical publications) and the project is essentially the same year to year, therefore much of the text of each report reiterates previously published information.

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INTRODUCTION

The Coso Monitoring Program was initiated in 1978 to gather baseline data on the surface and near-surface geothermal activity at Devils Kitchen and Coso Hot Springs, which are the main active thermal features within the Coso Known Geothermal Resource Area (Coso KGRA). These two sites are also located inside the boundaries of the Naval Air Weapons Station (NAWS), China Lake, CA. This report represents the twenty-first consecutive year of continuous data collection at these sites by Geothermal Program Office (GPO) personnel.

The format of the report for the current reporting period hasn't been changed from last year's report. A substantial body of reports has been established on this project (17 technical publications) and the project is essentially the same year to year, therefore much of the text of each report reiterates previously published information. This year's report concentrates on data presentation and interpretation and the reader is referred to the 1993/1994 summary report (Reference 1) for detailed descriptions of the overall project and the individual sites monitored.

Seasonal and diurnal variations of the thermal activity in these hot spring areas continue to be evident. Minor increases in thermal activity have been noted during this reporting period.

Monitoring sites of the Coso Hot Springs area and type of data collected at each site are presented in Table 1. The location of each site is shown in Figure 1.

TABLE 1. Monitoring Functions and Locations.

Monitored sites	Continuous steam flow	Wellhead pressure	Periodic water level	Periodic water temperature	Water level photography	Water chemistry	Ambient temperature	Barometric pressure	Relative humidity	Wind speed and direction
Schober s Resort (Wells 4A-2, 3)	X									
Well 4A-4			X[a]	X						
Well 4H-4	X									
Well 4P-1			X[b]	X		X				
Well 4H-8 (Coso No. 1)		X[c]		X						
Devils Kitchen	X					X				
Observation Well No. 1			X[b]	X		X				
Observation Well No. 2			X[b]							
South Pool			X[b]	X	X	X				
Weather Station							X	X	X	X

[a]Less than weekly monitoring.
[b]Weekly monitoring.
[c]Weekly shut-in wellhead pressures.

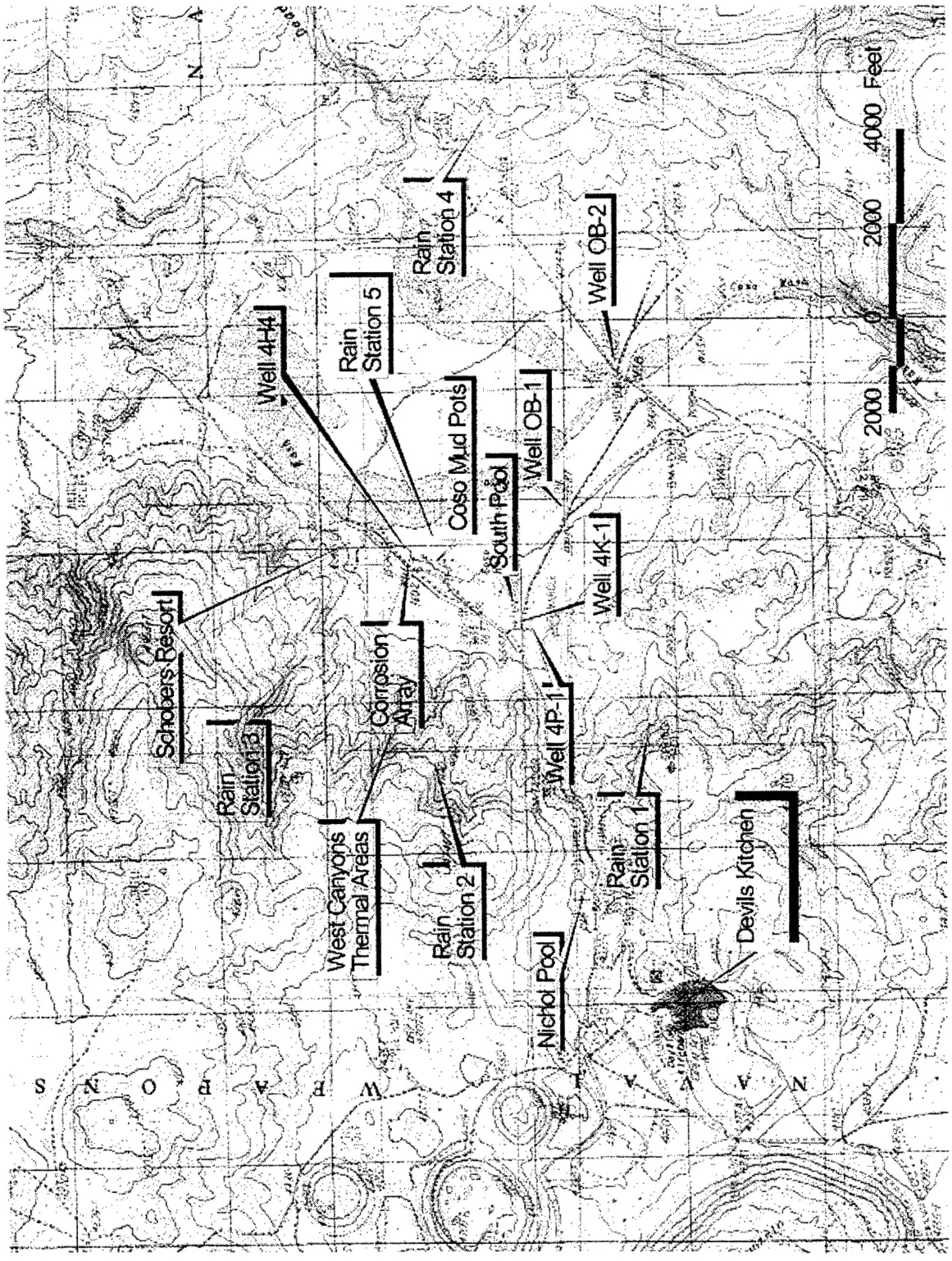


FIGURE 1. Coso Known Geothermal Resources Area Monitoring Sites.

STEAM FLOW AND TEMPERATURE MONITORING

Steam flow has been gauged at several shallow wells since the monitoring program was first initiated. While the measured steam flow from these wells represents an uncertain fraction of the total steam flow from the Coso thermal area, it does serve to monitor the relative hydrothermal activity in the area over time. Several sites are currently included in the study: Devils Kitchen, the Stove Pipe Eight-Inch Well (4H-4), and Schober's Resort (4A-2 and 3).

Steam flow data are recorded at each site using an ITT Barton differential pressure unit (DPU) chart recorder.

A periodic maintenance schedule was established in-house to ensure that the recording units are maintained at peak efficiency and reliability. The Chart recorder units were calibrated in September 2000 by the GPO personnel.

DEVILS KITCHEN

Steam flow at Devils Kitchen is monitored using a Barton 25-inch water DPU chart recorder. Daily high and low steam flow data collected at Devils Kitchen for the period of this report are presented in the Appendix. Figure 2 shows a summary graph of Devils Kitchen steam flow activity from October 1999 through September 2000.

The steam flow data recorded at Devils Kitchen has remained stable from 1 October 1999 through 30 September 2000. The increase and decrease in the chart data seems to be caused by seasonal changes, such as the increase and decrease in moisture in the thermal areas. Data was lost from 23 February 2000 through 14 March 2000 because of a chart mechanism malfunction.

STOVE PIPE EIGHT-INCH STEAM WELL (4H-4)

The daily steam flow for well 4H-4 is presented in the Appendix. This site is equipped with a 50-inch water column DPU chart recorder. Figure 3 shows a summary graph of steam flow activity from October 1999 through September 2000. The fluctuation of steam flow measured in the chart data from October 1999 through September 2000 is probably the result of seasonal changes in thermal activity around the Coso Corrison Array (Figure 4) next to well Coso 1. From past observations, when thermal activity increases around the Coso Corrison Array the DPU measurement at well 4H-4 decreases. When the thermal activity decreases around the Coso Corrison Array, the DPU measurement at 4H-4 increases. Data was lost from 7 March 2000 through 13 March 2000 and 24 August 2000 through 26 September 2000 because of a chart mechanism malfunction.

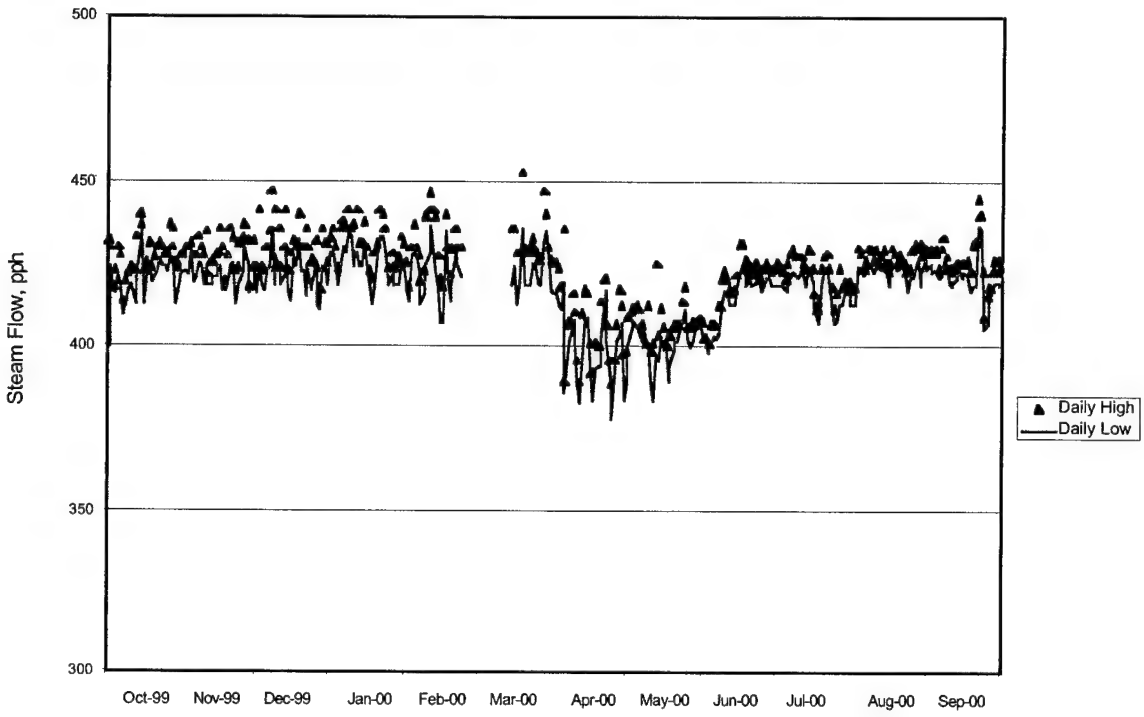


FIGURE 2. Devils Kitchen Steam Flow, October 1999 Through September 2000.

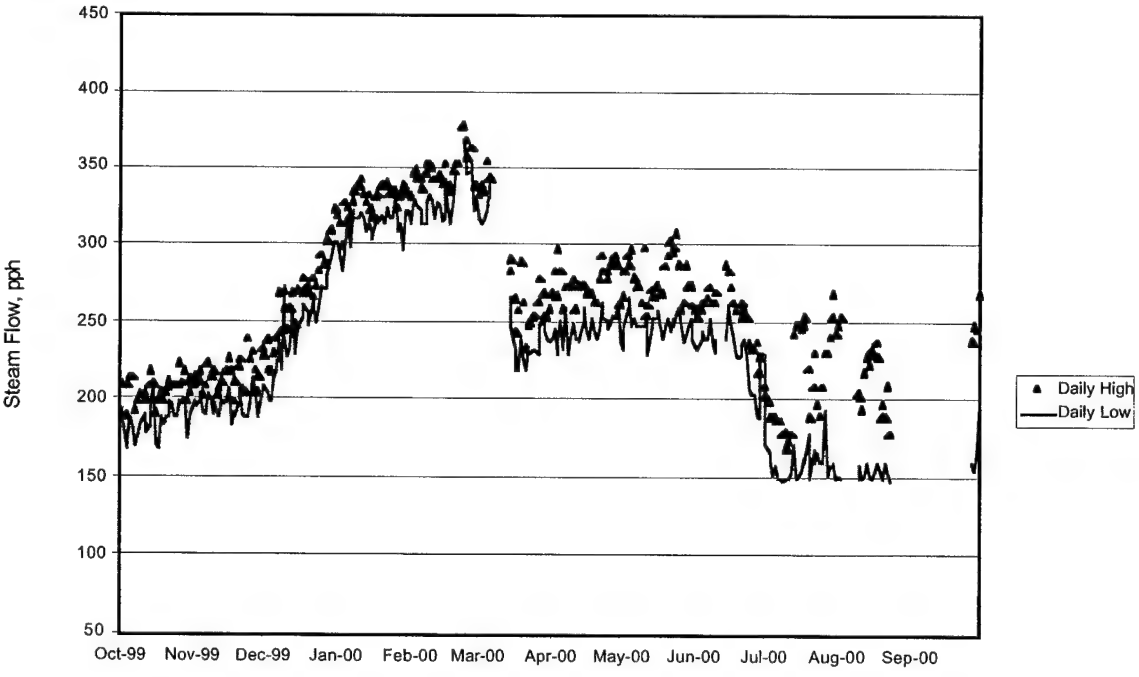


FIGURE 3. Well 4H-4 Steam Flow, October 1999 Through September 2000.

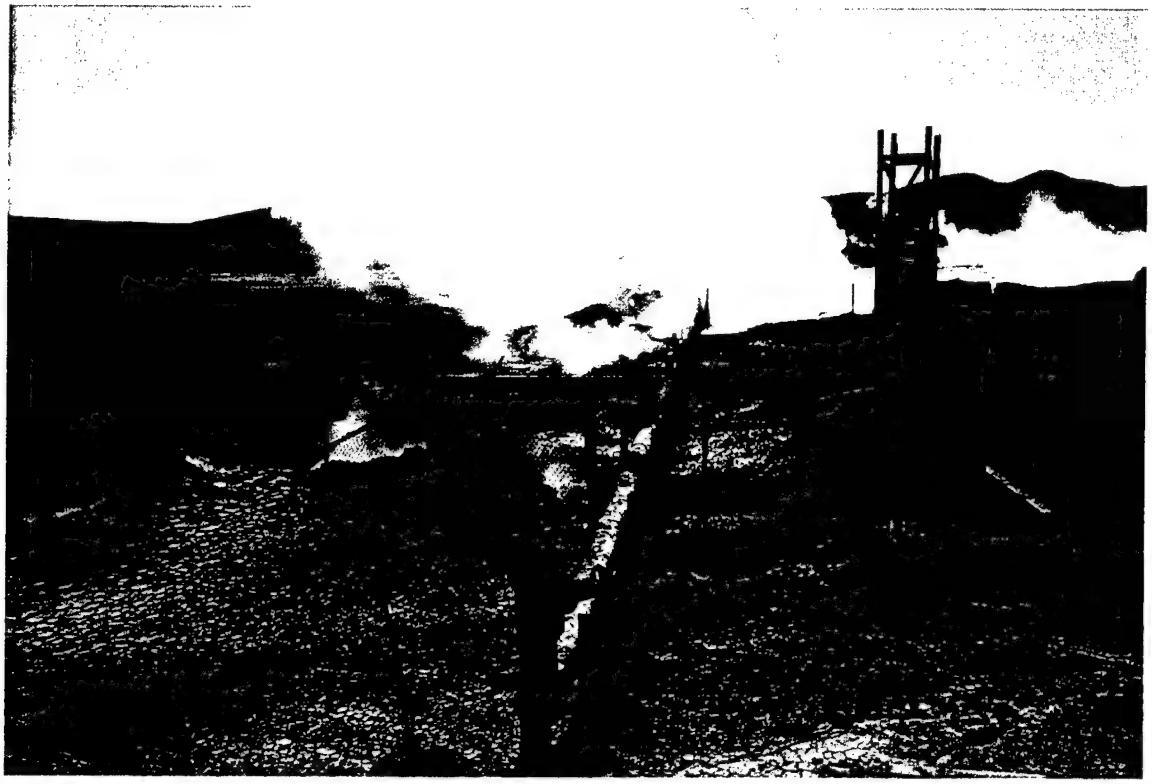


FIGURE 4. The Coso 1 Array, March 2000.

SCHOBER'S WELLS (4A-2 AND 4A-3)

The daily steam flow for wells 4A-2 and 4A-3 at Schober's Resort are presented in the Appendix. The Schober's Resort site is equipped with a 50-inch water column DPU and chart recorder. Figure 5 shows a summary graph of steam flow activity from October 1999 through 30 September 2000. From October 1999 through September 2000 the steam flow data recorded at Schober's Wells showed an increase about the same time period that the Coso 1 Array showed an increase in activity; steam flow data recorded at Schober's Wells tapered off as the activity in the Coso Array decreased.

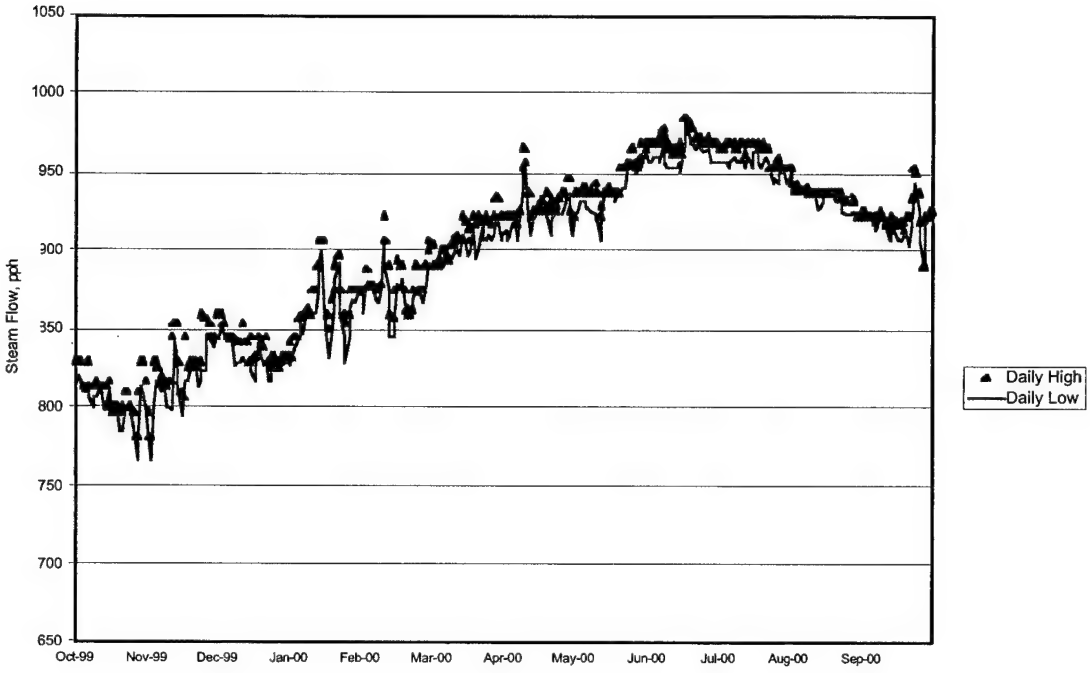


FIGURE 5. Schober's Resort Steam Flow, October 1999 Through September 2000.

COSO HOT SPRINGS MUDFIELD PHOTOGRAPHIC RECORD

A weekly photographic record was initiated in January 1978 to document the fluctuation in fluid levels in several of the more prominent mud pots in the Coso KGRA. Over the years the photo record has provided a clear picture of this hot springs thermal activity. It has demonstrated the sensitivity of the hot springs to both seasonal weather changes and individual weather events, such as summer thunderstorms. It has also chronicled the changes in thermal activity that occurred throughout the Coso Hot Springs area in the late 1980s. This record was continued through this reporting period and is catalogued and stored at the Geothermal Program Office.

Selected photographs, Figures 6 through 14, show the typical level of thermal activity in the hot springs area throughout the past year.

FIGURE 6. Resort Mud Pot Area, August 2000.

FIGURE 7. South Pool, High Water Level, May 2000.

FIGURE 8. South Pool, Low Water Level, October 1999.

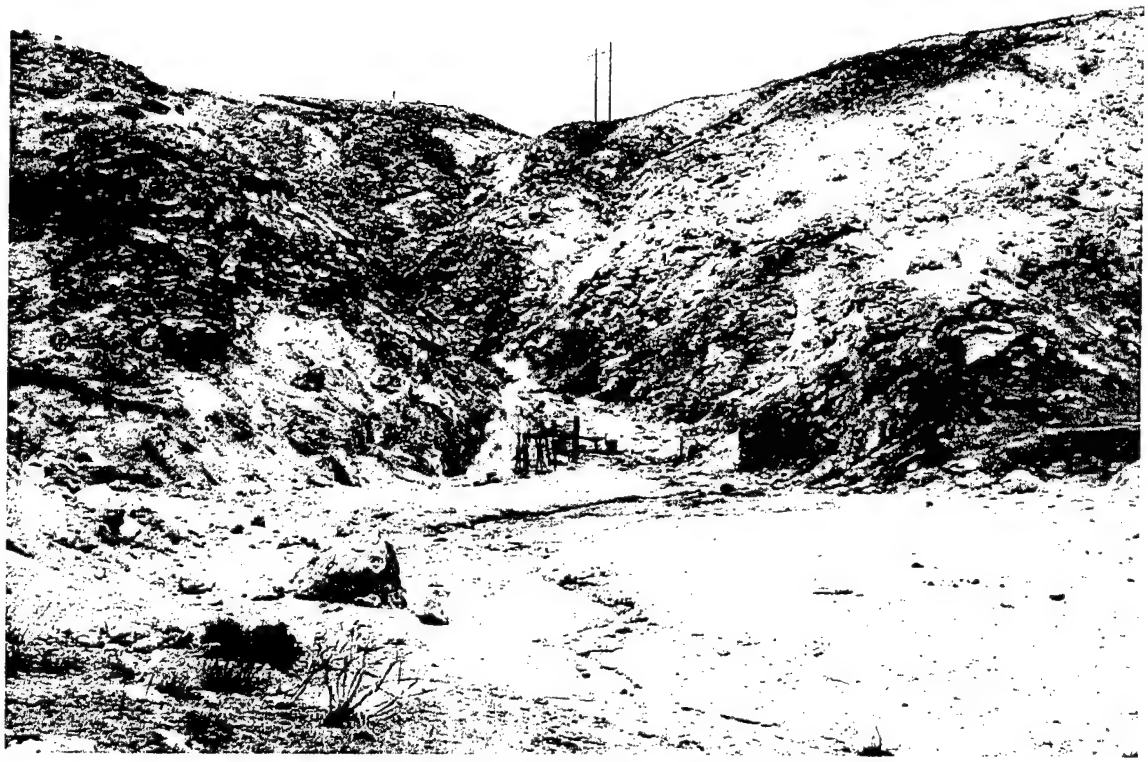


FIGURE 9. Devils Kitchen Area, September 2000.

FIGURE 10. Well 4H-4 Area, September 2000.

FIGURE 11. Schober's Resort Area, September 2000.

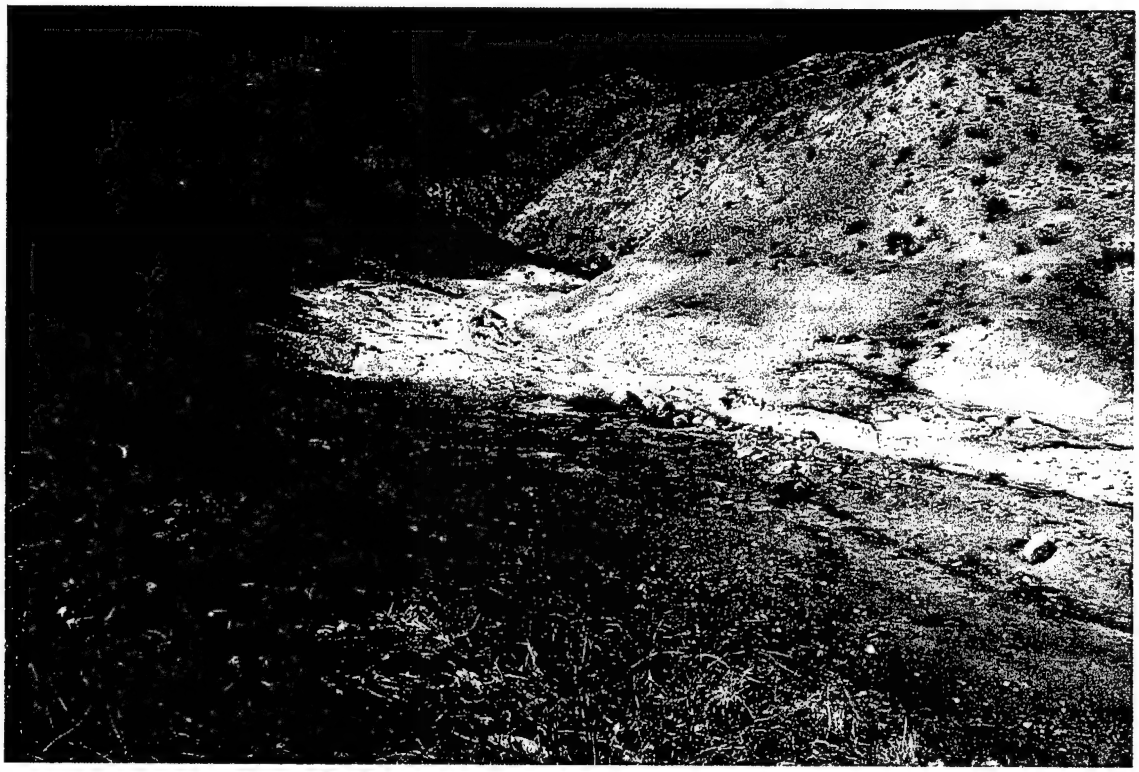


FIGURE 12. Northern West Canyon Land Slump, September 2000.

FIGURE 13. West Canyon Area, September 2000.

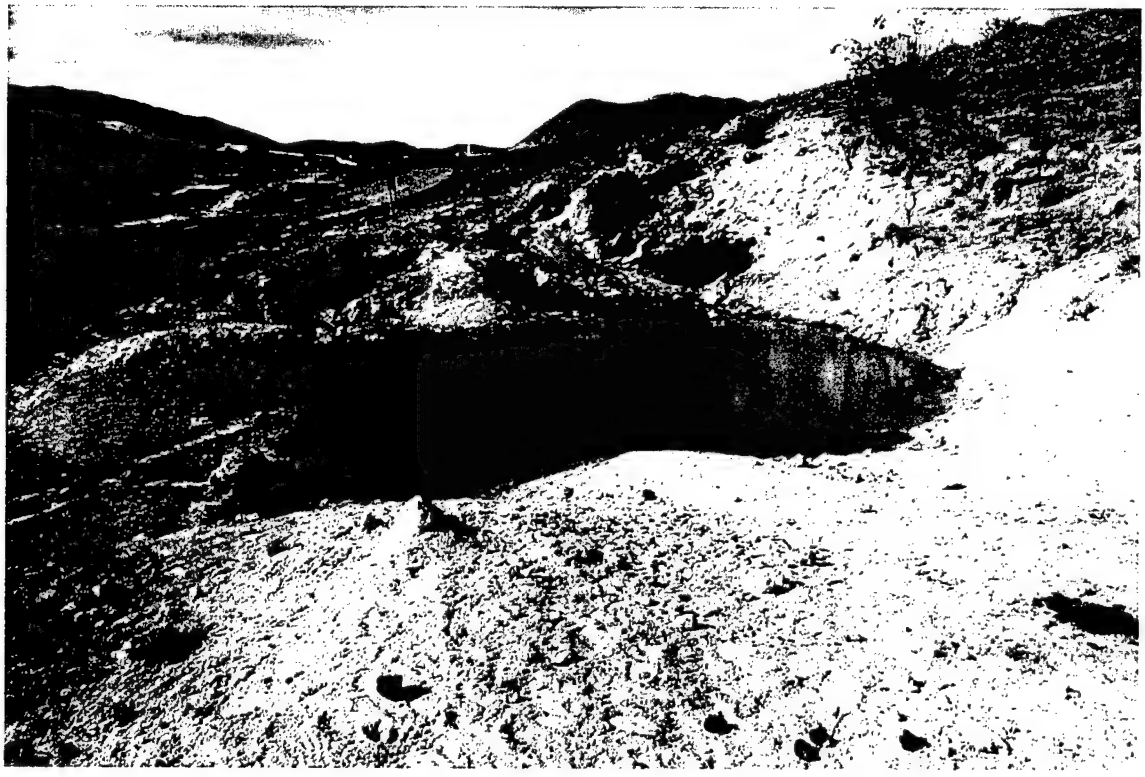


FIGURE 14. Nichol Prospect Warm Pool, September 2000.

WATER LEVEL MONITORING

OBSERVATION WELLS

Groundwater levels are monitored in four wells. Bi-weekly measurements are taken at wells 4P-1, OB-1, and OB-2, while the water level in Coso No. 1 (4H-8) is determined indirectly from temperature logs and weekly wellhead pressure readings. These level data are listed in Table 2. Figure 15 shows a summary graph of observation well water levels from 1980 to the present. Depth to water data have been translated to true elevation.

The fluid level elevation in well 4P-1 appears to have stabilized at 3612.1 feet above sea level (ASL) during this monitoring period. Well 4P-1 is a hot, steam condensate well and is located on the upthrown side of the Coso Hot Springs fault, about 150 feet west of the fault line, toward the south end of the hot springs area. It is completed in alluvial fill material. As discussed in Reference 2, this well appears to tap a small perched aquifer that is not directly connected to the regional aquifer.

Observation wells OB-1 and OB-2 are water wells located in the Upper Coso Basin about three-quarters of a mile east of the fault line. Both of these wells are completed in sedimentary valley fill material. The water level elevation in OB-1 continues to decline as described in previous reports, dropping from about 3432 feet ASL in 1988 to about 3364.3 feet ASL by September 2000. The water level in OB-2 declined from 3356.2 feet ASL in October 1998 to 3345.8 feet ASL in September 2000.

During September 2000, the GPO and the Coso field operator, Coso Operating Company, undertook the task of evaluating the condition and determining the current discharge rates of observation wells OB-1 and OB-2. Well OB-1 has sediment in the well piping to approximately 100 feet above the cleanout slots, making the pump inoperable. The lower section of the pump piping cannot be recovered. The pump on this well was removed and in the future this well will only be used for water level monitoring.

OB-2 was cleaned out to approximately 475 feet and the pump reinstalled; well flow was then tested. It sustained flow of ~50 gallons per minute after 60 minutes with a water level variation of 198 feet below ground level (initial) to 292 feet below ground level (final, stable). From this point on, water quality samples will be taken from OB-2 rather than OB-1. Water levels will continue to be taken from this well also.

Coso No. 1 is located toward the north end of the Coso Hot Springs fault and is completed in bedrock. The fluid level in Coso No. 1 declined slightly from 3473 feet to about 3465 feet ASL between 1978 and October 1987. At that lowered fluid level, the well began to boil. The fluid level then dropped rapidly to about 3410 feet ASL by September 1988, and the wellbore became plugged with salt and scale. Coso No. 1 was

rehabilitated in 1993 and shut-in to reduce boiling and scaling. The 2000 fluid level (determined from the temperature gradient log) was about 3295 feet ASL.

Shut-in wellhead pressures for Coso No. 1 are recorded weekly from both the 4-inch wellbore and the 7-inch intermediate casing around the wellbore. The wellbore is completed to 370 feet in bedrock, with the intermediate casing set to 194 feet at the alluvium/bedrock interface. Table 3 is a listing of the current year's recorded pressures. Figure 16 is a summary graph of these pressures from November 1993 through September 2000. On 20 June 2000 a faulty gauge on the 7-inch intermediate casing was replaced.

TABLE 2. Observation Well Water Level Data.

Date	Water level elevations, ft, above mean sea level (AMSL)			
	Ground level at well location, ft, AMSL			Ground level, ft, AMSL
	4P-1	OB-1	OB-2	Coso 1
	3662.0	3570.0	3560.0	3615.0
	Water level measurements			Water level
	4P-1	OB-1	OB-2	Coso 1
6 Oct 99	3612.1	3369.0	3349.3	
13 Oct 99	3612.1		3349.3	
20 Oct 99	3612.1		3349.3	
27 Oct 99	3612.1		3349.3	
3 Nov 99	3612.1		3349.3	
10 Nov 99	3612.1	3369.0	3349.3	
17 Nov 99	3612.1		3349.3	
24 Nov 99	3612.1		3348.2	
1 Dec 99	3612.1		3348.2	
8 Dec 99	3612.1	3369.0	3348.2	
15 Dec 99	3612.1		3348.2	
22 Dec 99	3612.1		3348.2	
29 Dec 99	3612.1		3348.2	
5 Jan 00				
12 Jan 00	3612.1	3367.6	3348.2	
19 Jan 00				
26 Jan 00	3612.1		3348.2	
2 Feb 00	3612.1		3348.2	
9 Feb 00	3612.1		3348.2	
16 Feb 00	3612.1	3367.0	3348.2	

TABLE 2. (Contd.)

Date	Water level elevations, ft, above mean sea level (AMSL)			
	Ground level at well location, ft, AMSL			Ground level, ft, AMSL
	4P-1	OB-1	OB-2	Coso 1
	3662.0	3570.0	3560.0	3615.0
	Water level measurements			Water level
	4P-1	OB-1	OB-2	Coso 1
23 Feb 00	3612.1		3348.2	
1 Mar 00	3612.1	3366.3	3348.2	
8 Mar 00				
15 Mar 00	3612.1		3348.2	
22 Mar 00	3612.1		3348.2	3295.0
29 Mar 00	3612.1	3366.3	3348.2	
5 Apr 00	3612.1		3348.2	
12 Apr 00	3612.1		3348.2	
19 Apr 00	3612.1	3365.9	3345.9	
26 Apr 00	3612.1		3347.0	
3 May 00	3612.1		3347.0	
10 May 00	3612.1	3365.7	3345.9	
17 May 00				
24 May 00				
31 May 00	3612.1		3345.9	
7 Jun 00	3612.1	3365.5	3345.9	
14 Jun 00	3612.1		3345.9	
21 Jun 00	3612.1		3347.0	
28 Jun 00	3612.1			
5 Jul 00				
12 Jul 00	3612.1			
19 Jul 00				
26 Jul 00	3612.1	3364.8	3355.9	
2 Aug 00	3612.1			
9 Aug 00	3612.1	3364.5	3355.7	
16 Aug 00	3612.1	3364.6	3355.8	
23 Aug 00	3612.1			
30 Aug 00	3612.1	3364.3	3355.8	
6 Sep 00	3612.1			
13 Sep 00	3612.1			
20 Sep 00	3612.1			
27 Sep 00	3612.1			

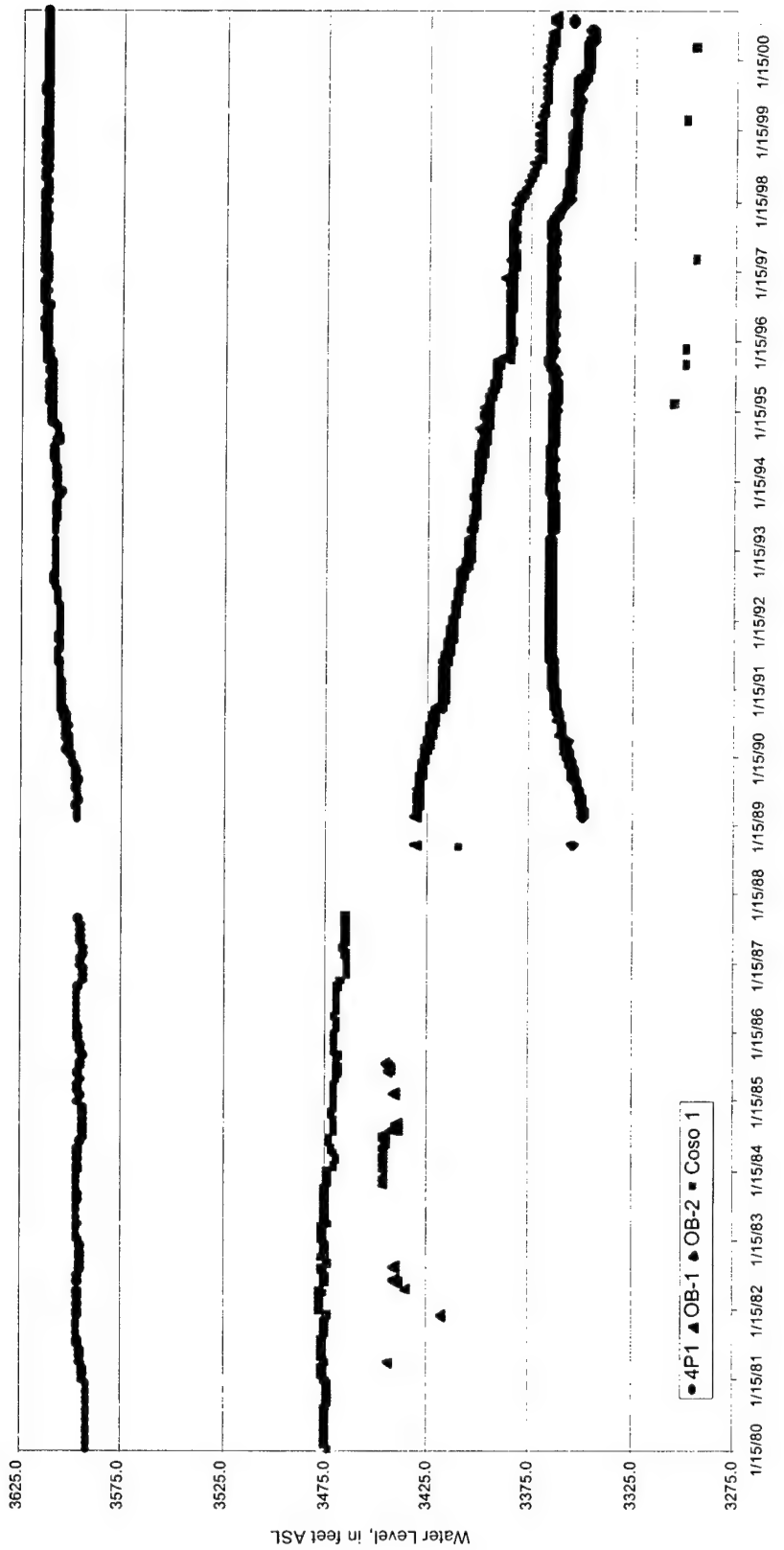


FIGURE 15. Water Levels in Coso Observation Wells, January 1980 Through September 2000.

TABLE 3. Shut-in Wellhead Pressure, Coso No. 1.

Date	7-inch casing (psig)	4-inch casing (psig)
6 Oct 99	26.0	21.0
13 Oct 99	26.0	22.0
20 Oct 99	26.0	22.0
27 Oct 99	26.0	22.0
3 Nov 99	26.0	22.0
10 Nov 99	26.0	22.0
17 Nov 99	26.0	22.0
24 Nov 99	26.0	22.0
1 Dec 99	26.0	22.0
8 Dec 99	26.0	22.0
15 Dec 99	26.5	22.0
22 Dec 99	26.5	22.0
29 Dec 99	27.0	23.0
5 Jan 00	n.d.	n.d.
12 Jan 00	27.0	23.0
19 Jan 00	n.d.	n.d.
26 Jan 00	27.0	23.0
2 Feb 00	27.0	24.0
9 Feb 00	27.5	24.5
16 Feb 00	27.0	23.0
23 Feb 00	28.0	24.0
1 Mar 00	29.0	23.0
8 Mar 00	n.d.	n.d.
15 Mar 00	30.0	26.0
22 Mar 00	27.0	26.0
29 Mar 00	27.0	26.0
5 Apr 00	27.0	27.0
12 Apr 00	27.0	27.0
19 Apr 00	27.0	27.0
26 Apr 00	27.0	27.0
3 May 00	27.0	27.0
10 May 00	27.0	27.0
17 May 00	n.d.	n.d.
23 May 00	n.d.	n.d.
31 May 00	28.0	28.0
7 Jun 00	28.0	28.0
14 Jun 00	27.5	27.0
21 Jun 00	28.0	28.0
28 Jun 00	28.0	27.5
5 Jul 00	n.d.	n.d.
12 Jul 00	27.5	27.0
19 Jul 00	n.d.	n.d.
26 Jul 00	26.0	27.0
2 Aug 00	26.0	27.0
9 Aug 00	26.0	26.0
16 Aug 00	26.0	27.0
23 Aug 00	26.0	26.0
30 Aug 00	26.0	26.0
6 Sep 00	26.0	26.0
13 Sep 00	26.0	26.0
20 Sep 00	26.0	26.0
27 Sep 00	26.0	26.0

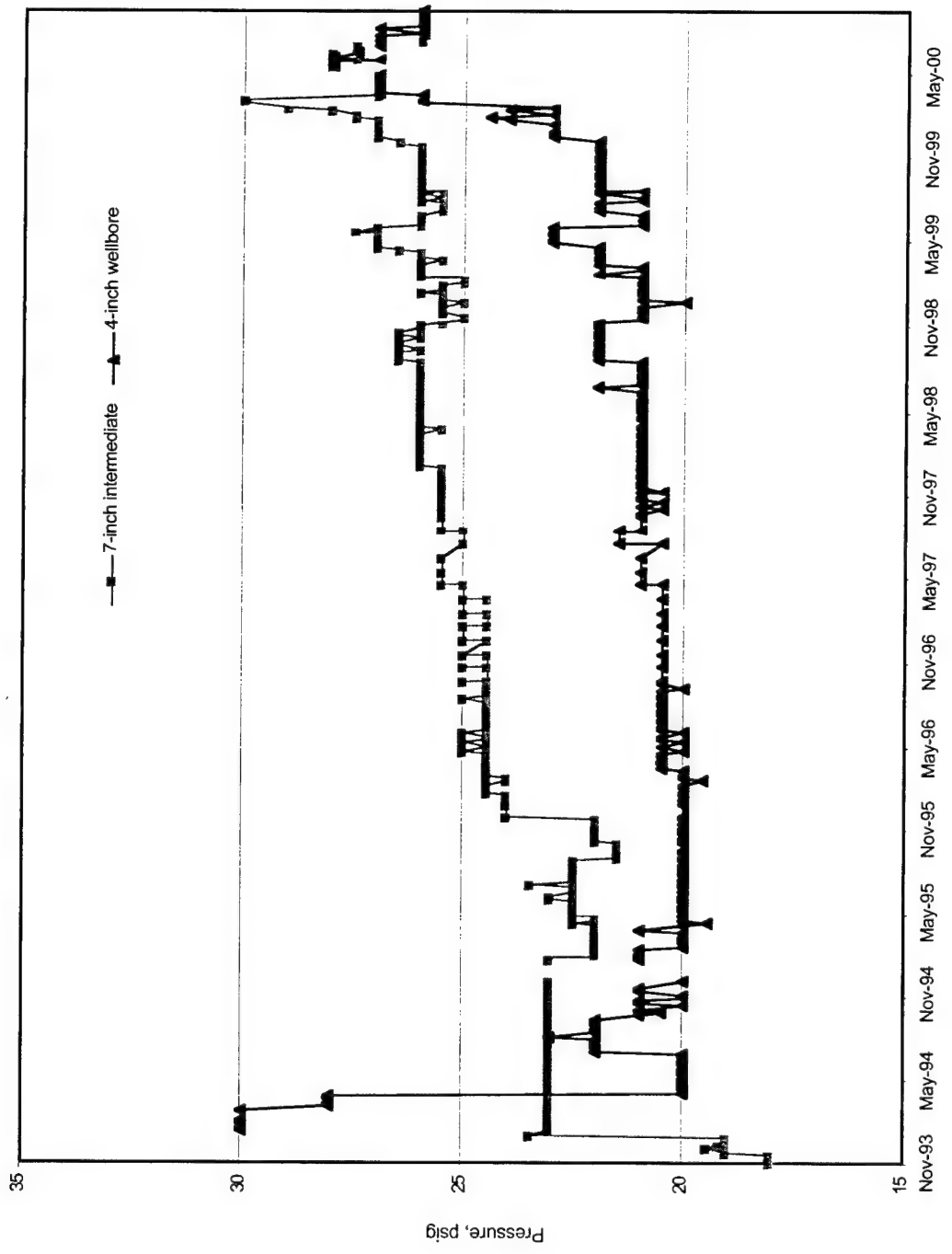


FIGURE 16. Shut-in Wellhead Pressure, Coso Well No. 1, November 1993 Through September 2000.

SOUTH POOL

The South Pool water level has continued the pattern of seasonal fluctuations throughout this reporting period, ranging from a low of 3617.5 feet in October 1999 to a high of 3621.4 feet in May 2000 (Table 4). The pool's temperature is periodically measured, as conditions permit. Water temperatures for this period continued to average above 200 degrees (F). The temperature and water elevations of the pool for January 1988 through September 2000, the period of increased activity, are shown graphically in Figure 17, while the pool elevation recorded for the entire monitoring program period is shown in Figure 18.

TABLE 4. South Pool Elevation and Temperature Changes.

Date	Elevation, ft	Temperature, °F	Date	Elevation, ft	Temperature, °F
6 Oct 99	3617.5	205	12 Apr 00	3621.1	204
13 Oct 99	3617.5	205	19 Apr 00	3621.2	203
20 Oct 99	3617.9	209	26 Apr 00	3621.1	206
27 Oct 99	3618.2	208	3 May 00	3620.9	206
3 Nov 99	3618.4	206	10 May 00	3620.5	207
10 Nov 99	3618.0	205	17 May 00		
17 Nov 99	3617.9	203	24 May 00		
24 Nov 99	3617.8	204	31 May 00	3621.4	209
1 Dec 99	3617.7	206	7 Jun 00	3619.2	207
8 Dec 99	3617.6	204	14 Jun 00	3619.0	209
15 Dec 99	3617.6	204	21 Jun 00	3618.8	210
22 Dec 99	3617.5	206	28 Jun 00	3618.6	211
29 Dec 99	3617.5	203	5 Jul 00		
5 Jan 00			12 Jul 00	3618.5	210
12 Jan 00	3617.5	205	19 Jul 00		
19 Jan 00			26 Jul 00	3618.5	207
26 Jan 00	3617.5	204	2 Aug 00	3618.5	209
2 Feb 00	3618.5	205	9 Aug 00	3618.4	210
9 Feb 00	3619.6	204	16 Aug 00	3618.3	210
16 Feb 00	3620.3	203	23 Aug 00	3618.2	208
23 Feb 00	3620.3	203	30 Aug 00	3618.2	206
1 Mar 00	3620.4	202	6 Sep 00	3617.9	205
8 Mar 00			13 Sep 00	3617.7	206
15 Mar 00	3621.0	203	20 Sep 00	3617.6	209
22 Mar 00	3621.0	204	27 Sep 00	3617.5	211
29 Mar 00	3621.1	205			
5 Apr 00	3621.1	204			

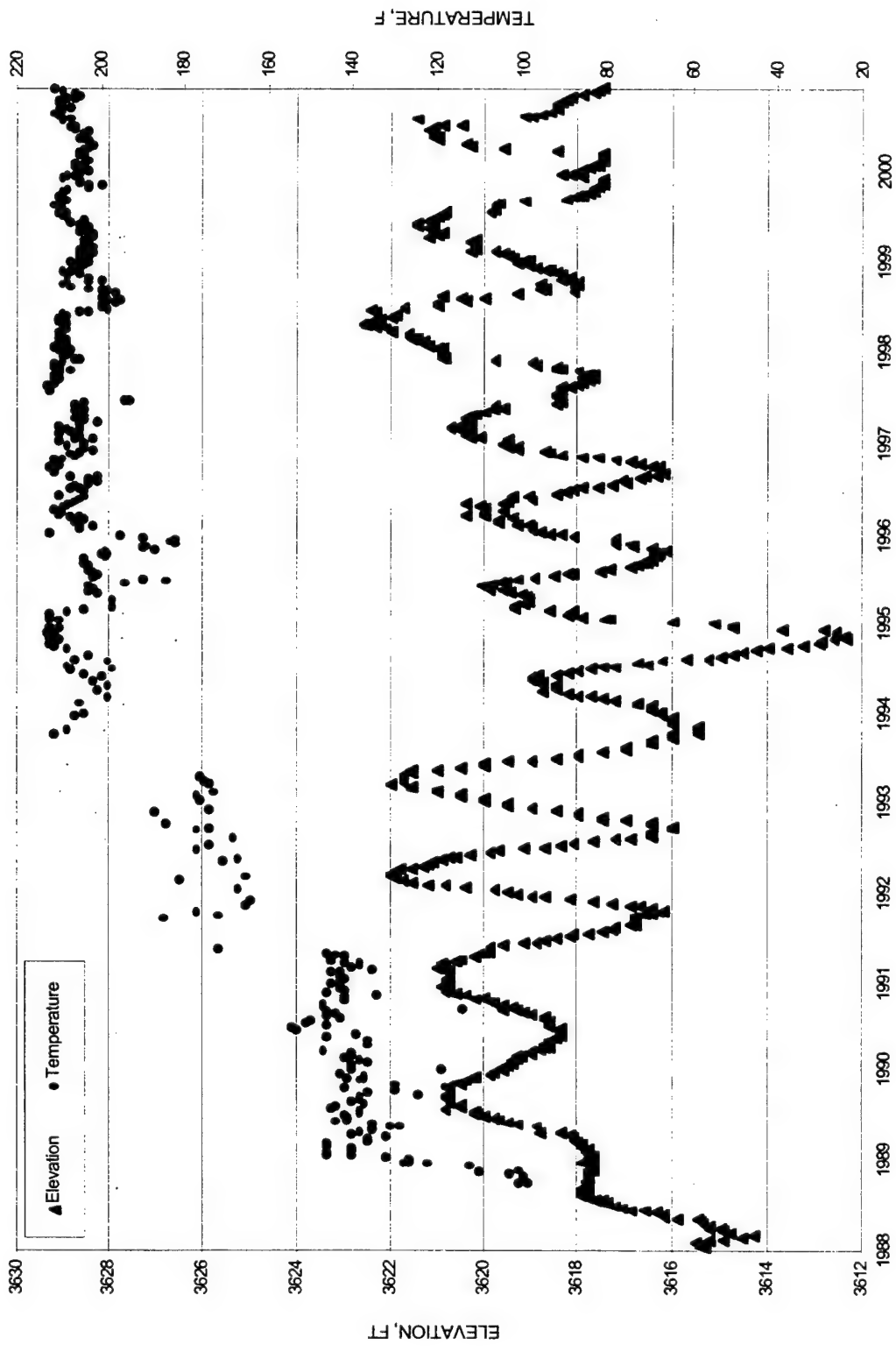


FIGURE 17. South Pool Elevation and Temperature, January 1988 Through September 2000.

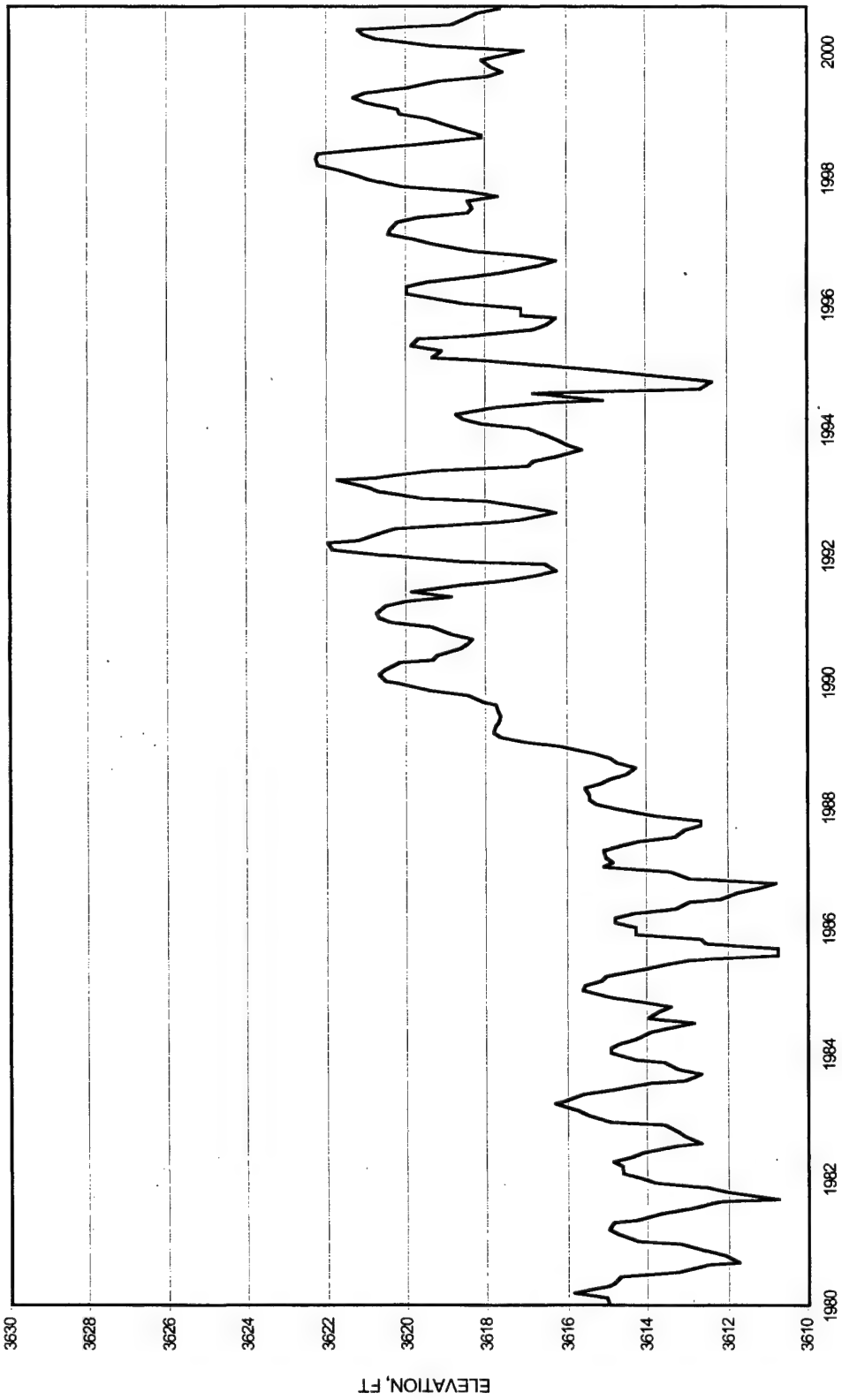


FIGURE 18. South Pool Elevations, January 1980 Through September 2000.

RAINFALL AT COSO RESORT AREA AND ROSE VALLEY

Rainfall in the Coso Hot Springs basin is monitored at five rain station sites, as mapped on Figure 1. Instrumentation at each site consists of an electronic event data logger that is triggered by a tipping bucket. The Rose Valley data are collected at the Los Angeles Department of Water and Power Haiwee Reservoir Plant.

Data from the Coso rain stations and the Rose Valley data from the Haiwee power plant are presented in Table 5 and Figure 19. Comparative rainfall data for Coso Basin, Rose Valley, and the Indian Wells Valley (IWV) for the period 1968 through 2000 are shown in Figure 20 and Table 6. IWV data were gathered at Armitage Field, Naval Air Warfare Center Weapons Division (NAWCWD), and provided by a NAWCWD meteorologist.

Data from the Coso rain stations 1, 2, and 5 have no data because of a malfunction with the data recorders. New batteries were installed and the recorders were reprogrammed. The tipping buckets were cleaned and checked. These rain stations will be monitored throughout the year to ensure they are working properly.

TABLE 5. Rainfall Recorded at the Coso Rain Stations and Rose Valley.

Coso Hot Springs area						Rose Valley	
Date	Tipping bucket stations (rainfall, in.)					Date	Rainfall, in.
	1	2	3	4	5		
3 Nov 99			0.02				
10 Nov 99				0.01			
17 Jan 99			0.14	0.04			
						18 Jan 00	0.07
						19 Jan 00	0.01
						25 Jan 00	0.01
						21 Jan 00	0.08
						11 Feb 00	0.27
12 Feb 00				0.09		12 Feb 00	0.16
						13 Feb 00	0.01
						14 Feb 00	0.01
16 Feb 00			0.12				
						17 Feb 00	0.02
20 Feb 00			0.15	0.05		20 Feb 00	0.04
21 Feb 00			0.19	0.27		21 Feb 00	1.15
						22 Feb 00	0.01
23 Feb 00			0.14	0.21		23 Feb 00	0.04
						24 Feb 00	0.12
						26 Feb 00	0.04
						28 Feb 00	0.02
5 Mar 00			0.32				
6 Mar 00			0.17			6 Mar 00	0.92
8 Mar 00			0.08			8 Mar 00	0.02
						9 Mar 00	0.17

TABLE 5. (Contd.)

Coso Hot Springs area						Rose Valley	
Date	Tipping bucket stations (rainfall, in.)					Date	Rainfall, in.
	1	2	3	4	5		
						10 Mar 00	0.01
						14 Apr 00	0.03
17 Apr 00			0.24	0.07		17 Apr 00	0.10
						18 Apr 00	0.01
3 Aug 00							
28 Aug 00			0.01				
			0.07	0.03			
						29 Aug 00	0.52
						30 Aug 00	0.01
TOTAL			1.65	0.77		TOTAL	3.85

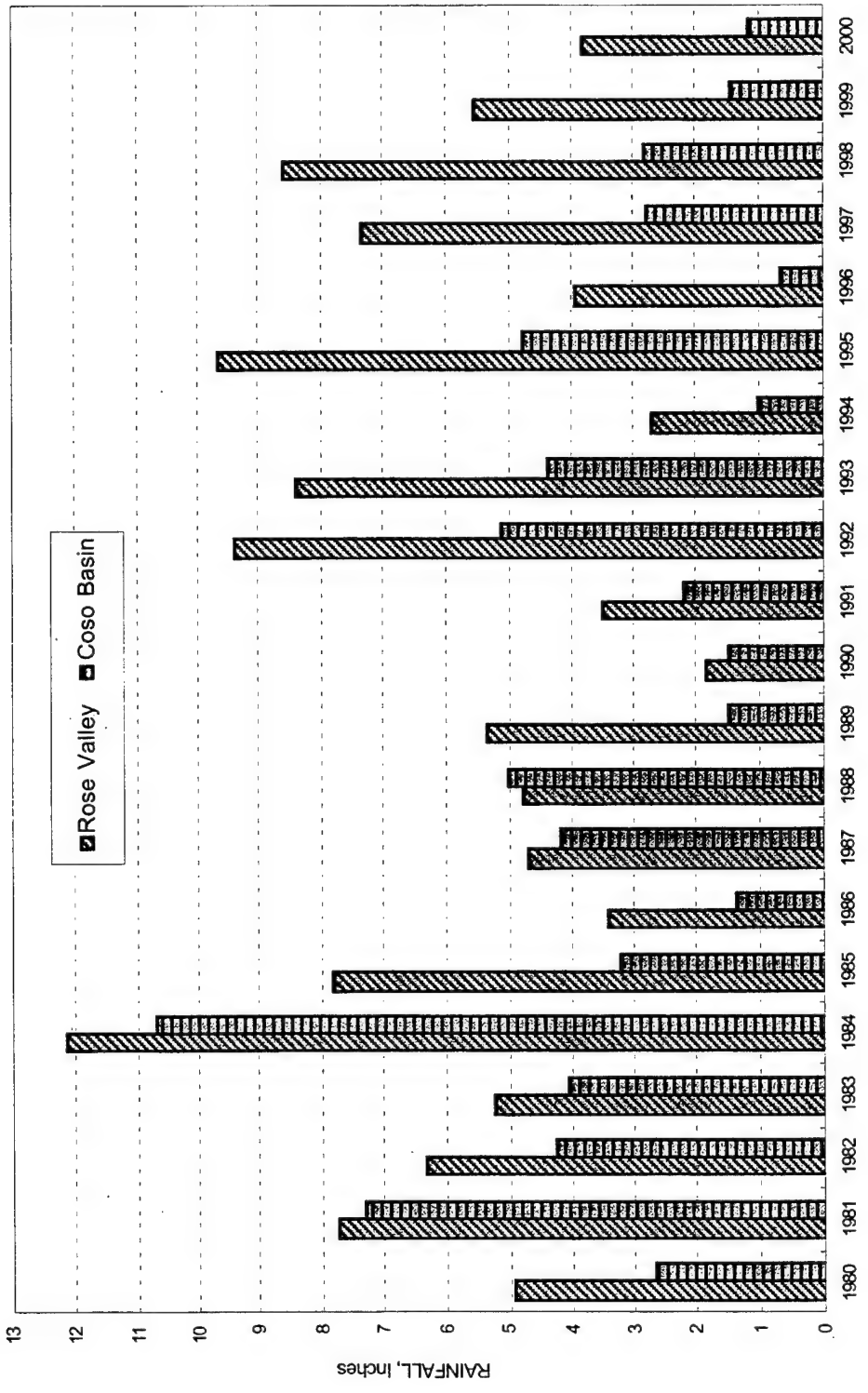


FIGURE 19. Comparison of Total Rainfall at Coso Basin and Rose Valley, 1980 Through 2000.

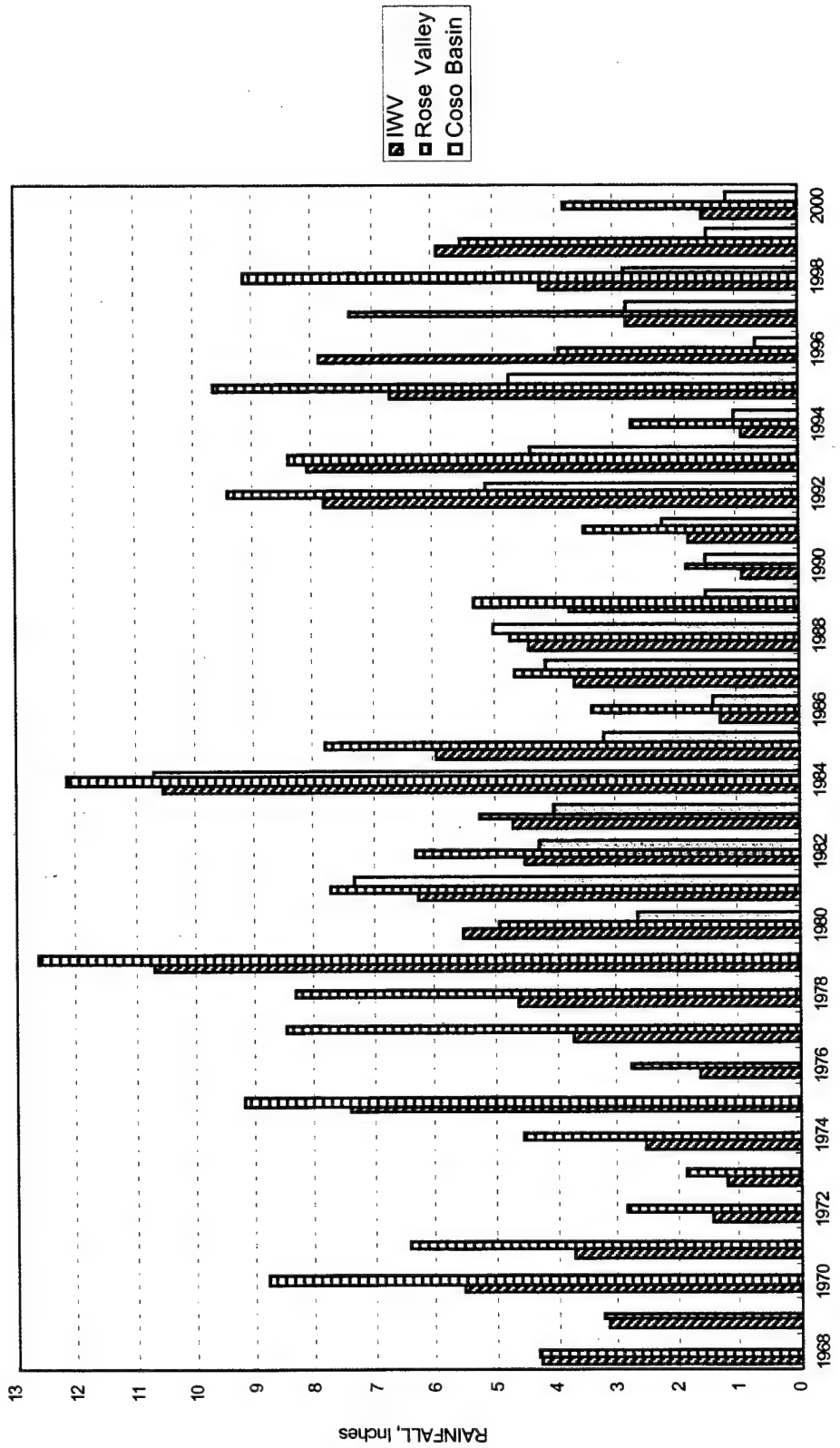


FIGURE 20. Comparison of Total Rainfall at Coso Basin, Rose Valley, and IWV Sites, 1968 Through 2000.

TABLE 6. IWV, Rose Valley, and Coso Basin Rainfall, in Inches.

Fiscal Year	IWV	Rose Valley	Coso Basin
1968	4.28	4.32	
1969	3.16	3.26	
1970	5.55	8.80	
1971	3.74	6.45	
1972	1.47	2.87	
1973	1.24	1.90	
1974	2.58	4.56	
1975	7.46	9.19	
1976	1.64	2.79	
1977	3.74	8.50	
1978	4.67	8.34	
1979	10.68	12.61	
1980	5.56	4.97	2.67
1981	6.31	7.75	7.34
1982	4.49	6.34	4.28
1983	4.73	5.26	4.05
1984	10.56	12.14	10.70
1985	5.95	7.84	3.23
1986	1.29	3.42	1.42
1987	3.68	4.68	4.19
1988	4.43	4.77	5.04
1989	3.76	5.36	1.51
1990	0.94	1.85	1.51
1991	1.78	3.53	2.24
1992	7.83	9.41	5.15
1993	8.10	8.4	4.38
1994	0.94	2.74	1.04
1995	6.76	9.69	4.78
1996	7.88	3.94	0.69
1997	2.82	7.37	2.83
1998	4.25	8.64	2.87
1999	5.94	5.54	1.49
2000	1.58	3.85	1.21

COSO HOT SPRINGS MINI-WEATHER RECORDING STATION

Barometric pressure, ambient temperature, relative humidity, and wind speed and wind direction are recorded at Weather Station 1, located adjacent to observation well OB-1. In March 1996 this station was integrated into the base-wide weather monitoring network. This site is maintained by NAWCWD Geophysics Operation personnel (Code 521410D).

Barometric pressure, ambient temperature, and relative humidity data are presented in Figure 21. Actual hourly data are expansive and will not be published. They are available from the Geothermal Program Office upon request.

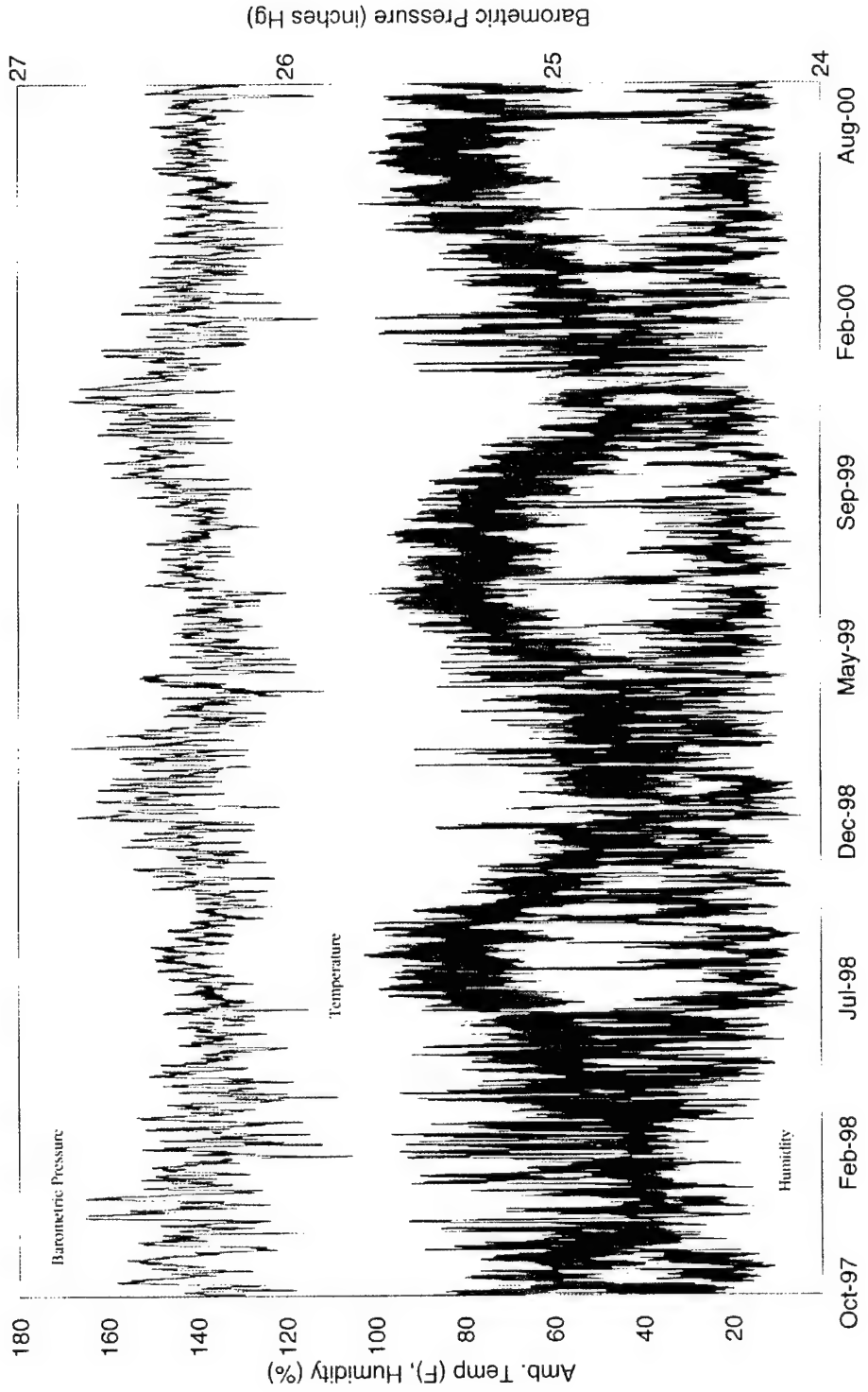


FIGURE 21. Weather Station One, Hourly Data, 1 October 1996 Through 30 September 2000.

WATER ANALYSIS OF COSO HOT SPRINGS AREA

Water samples were collected from several sites in the Coso Hot Springs area. These samples were analyzed for a suite of geothermal constituents by Western Analysis, Inc., of Salt Lake City, Utah. The results are provided in Table 7. Wells 4K-1, 4P-1, and OB-2, as well as sites at Devils Kitchen, Fault Line, Nichol Pool, South Pool, Slump Canyon, and West Canyon, were analyzed.

TABLE 7. Chemical Analysis of Coso Area Surface and Near-Surface Thermal Waters.

Constituents	Units	Slump Canyon 03/24/00	Slump Canyon 09/26/00	4K-1 03/24/00	4K-1 09/26/00	4P-1 03/24/00	4P-1 09/26/00	Devils Kitchen 03/24/00	Devils Kitchen 09/26/00	Nicol Pool 03/24/00	Nicol Pool 09/26/00	West Canyon 03/24/00	West Canyon 09/26/00	South Pool 03/24/00	OB-2 09/26/00	Fault Line 09/26/00
Aluminum	mg/L	nd	6.460	nd	na	nd	nd	0.840	24.900	nd	2.270	nd	2.880	8.240	nd	96.500
Antimony	mg/L	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Arsenic	mg/L	0.905	nd	0.012	nd	0.135	nd	0.039	nd	nd	na	nd	nd	1.010	2.550	nd
Bicarbonate	mg/L	na	na	41.200	41.700	61.800	76.500	na	na	na	na	na	na	na	320.000	na
Boron	mg/L	0.090	0.190	0.830	0.498	1.420	0.670	3.599	4.140	19.330	14.900	0.710	0.542	5.110	6.070	4.300
Bromide	mg/L	1.290	na	2.050	nd	1.210	a	5.220	17.000	3.980	8.200	8.950	9.780	2.570	4.410	13.500
Calcium	mg/L	50.340	30.840	12.450	3.880	120.700	115.900	67.802	53.460	46.520	31.700	103.800	76.580	104.930	7.340	75.100
Carbonate	mg/L	na	na	nd	nd	nd	nd	na	na	na	na	na	na	na	nd	na
Chloride	mg/L	6.980	nd	5.110	5.580	66.200	122.700	nd	nd	988.000	889.000	8.140	nd	nd	163.000	nd
Conductivity	mhos/cm	766	875	243	275	1720	1990	3980	4930	3450	3530	1140	1110	2460	1595	10130
Copper	mg/L	0.160	nd	0.150	0.157	na	na	na	na	nd	na	nd	nd	0.210	nd	0.190
Fluoride	mg/L	0.330	0.360	2.010	2.300	0.330	0.380	0.508	0.140	0.160	0.110	0.350	0.170	0.640	0.990	nd
Iron	mg/L	6.430	16.740	3.220	1.182	5.440	2.880	21.980	52.400	28.700	27.190	4.930	6.160	199.800	nd	207.500
Lithium	mg/L	na	0.030	0.050	0.061	0.290	0.240	0.119	0.080	2.730	2.160	0.070	0.034	0.090	1.630	0.090
Magnesium	mg/L	13.890	7.950	2.450	0.096	5.440	1.540	24.955	17.830	9.240	7.120	22.030	15.070	54.750	0.950	41.050
Manganese	mg/L	1.630	1.280	0.410	0.074	1.750	1.980	2.115	2.080	1.120	1.000	4.450	3.363	4.640	0.230	2.740
Mercury	ppb	0.0002	0.0002	0.010	0.008	0.0011	0.0014	0.0018	0.0019	0.0024	0.0017	0.0086	0.0034	0.0002	0.0002	0.005
pH	pH units	3.57	2.92	6.71	6.18	6.76	6.42	2.25	1.68	2.58	2.19	4.00	4.03	2.57	7.38	1.52
Potassium	mg/L	20.090	18.620	11.090	9.470	133.200	122.980	40.000	36.400	114.930	84.940	41.890	30.070	49.090	14.240	21.900
Selenium	ppb	na	< 10	na	0.010	na	0.010	na	0.013	na	0.016	na	0.010	na	0.012	0.028
Silica	mg/L	250.900	266.900	341.860	304.700	428.700	428.000	440.300	354.500	381.900	446.800	329.000	378.000	442.210	58.200	417.000
Sodium	mg/L	60.870	55.970	48.200	51.360	289.900	297.200	62.280	43.800	548.850	423.900	151.700	107.880	45.600	216.580	57.690
Strontium	mg/L	0.080	0.130	0.070	0.050	2.450	2.210	0.124	0.150	0.210	0.180	0.640	0.237	0.100	0.280	0.160
Sulfate	mg/L	314.000	362.000	148.400	64.900	853.000	794.000	824.000	1480.000	356.000	336.000	615.000	471.000	1180.000	60.900	2850.000
TDS	mg/L	795	790	622	470	1920	1840	1448	2045	2539	2240	1260	1050	2230	675	152
Thallium	PPM	< 0.01	< 0.20	< 0.01	<. 0.20	< 0.01	< 0.20	< 0.01	< 0.20	< 0.01	< 0.20	< 0.01	< 0.20	< 0.01	< 0.20	< 0.21
Zinc	mg/L	0.440	na	3.200	0.238	0.830	0.260	0.135	0.410	0.100	0.080	0.080	0.056	0.850	0.130	0.200

nd (not detected)
na (not analyzed)

TEMPERATURE RECORDINGS OF THE COSO RESORT AREA WELLS

The temperature logs from wells 4K-1, 4P-1, and Coso 1 are graphed in Figure 22, with the data listed in Tables 8 through 10. OB-1 is nearly dry, so there is no temperature log. Temperature logs and water samples will be taken on OB-2 instead of OB-1. These data were recorded by Geothermal Office personnel using the TD Probe System, manufactured by Natural Progress Instruments, Dallas, Texas.

TABLE 8. Temperature Recordings at Well 4K-1.

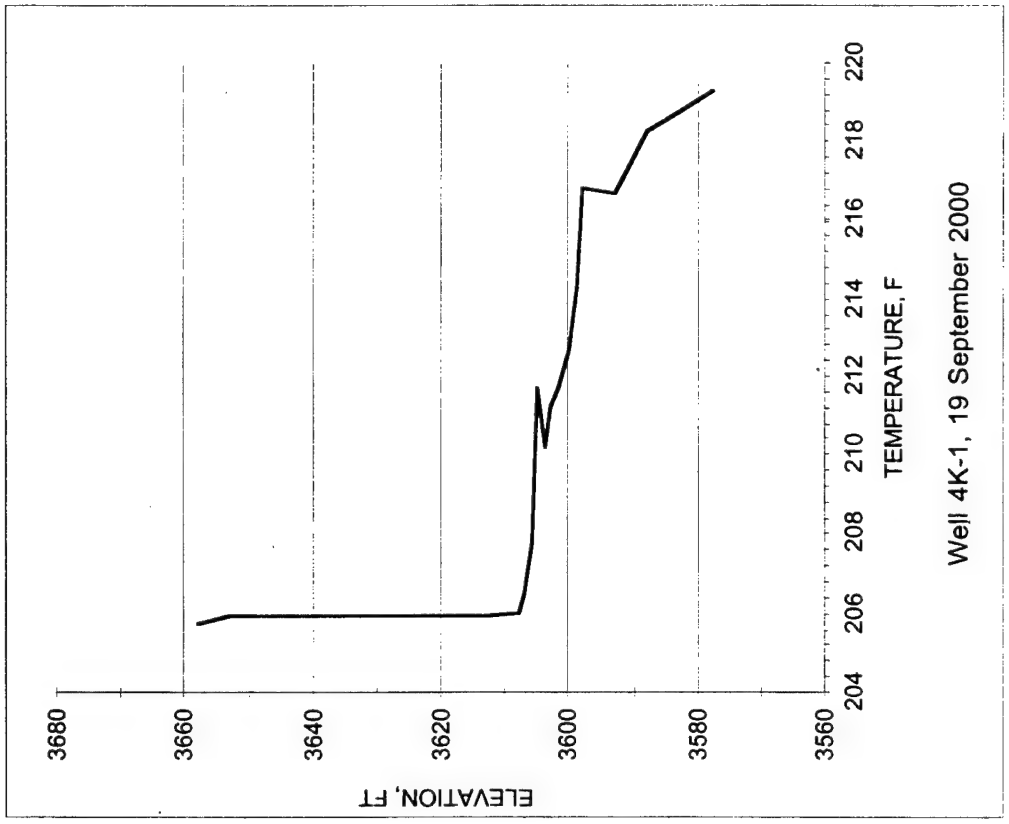
Depth, ft	Elevation, ft AMSL	Temperature °F on 24 Mar 00	Temperature °F on 13 Sep 00
-0	3658	205.6	205.7
-5	3653	205.7	205.9
-10	3648	205.7	205.9
-15	3643	205.7	205.9
-20	3638	205.7	205.9
-25	3633	205.7	205.9
-30	3628	205.7	205.9
-35	3623	205.7	205.9
-40	3618	205.7	205.9
-45	3613	205.7	205.9
-50	3608	205.8	206.0
-51	3607	207.3	206.5
-52	3606	212.2	207.7
-53	3605	210.2	211.6
-54	3604	211.0	210.2
-55	3603	211.2	211.2
-56	3602	211.2	211.6
-57	3601	211.6	212.2
-58	3600	212.0	212.6
-59	3599	212.6	214.3
-60	3598	214.5	216.8
-65	3593	215.2	216.7
-70	3588	216.0	218.2
-75	3583	218.5	218.7
-80	3578	218.6	219.2

TABLE 9. Temperature Recordings at Well 4P-1.

Depth, ft	Elevation, ft AMSL	Temperature °F on 24 Mar 00	Temperature °F on 22 Sep 99
0	3662	195.7	194.9
-5	3657	197.3	205.3
-10	3652	198.1	206.2
-15	3647	205.9	206.1
-20	3642	205.9	206.0
-25	3637	205.9	205.9
-30	3632	205.9	205.9
-35	3627	205.9	205.9
-40	3622	206.1	205.9
-45	3617	206.1	205.8
-50	3612	206.2	205.8
-55	3607	209.0	209.1
-60	3602	213.7	212.9
-65	3597	217.9	218.1
-70	3592	224.6	222.8
-75	3587	223.3	223.5
-80	3582	225.2	224.3
-85	3577	226.5	226.2
-90	3572	228.5	228.1
-95	3567	237.0	235.2
-100	3562	241.2	240.3
-105	3557	246.3	240.3

TABLE 10. Temperature Recordings at Coso 1.

Depth, ft	Elevation, ft AMSL	Temperature °F on 24 Mar 00
0	3615	263.6
-20	3595	265.3
-40	3575	265.3
-60	3555	265.0
-80	3535	265.3
-100	3515	265.6
-120	3495	265.6
-140	3475	265.9
-160	3455	265.9
-180	3435	265.9
-200	3415	265.9
-220	3395	265.9
-240	3375	265.9
-260	3355	265.9
-280	3335	265.9
-300	3315	265.9
-305	3310	266.2
-310	3305	266.2
-315	3300	268.6
-320	3295	268.6
-340	3275	268.6
-360	3255	268.9
-365	3250	269.2



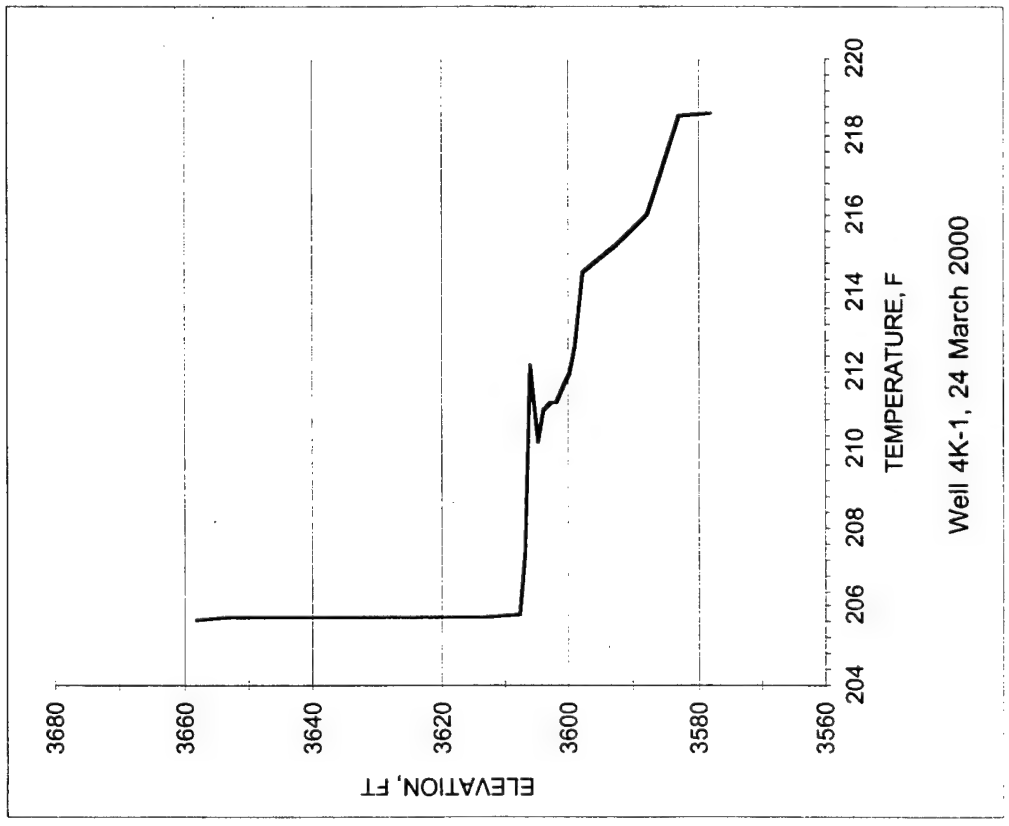


FIGURE 22. Temperature Gradient Logs, Wells 4K-1, 4P-1, and Coso No. 1.

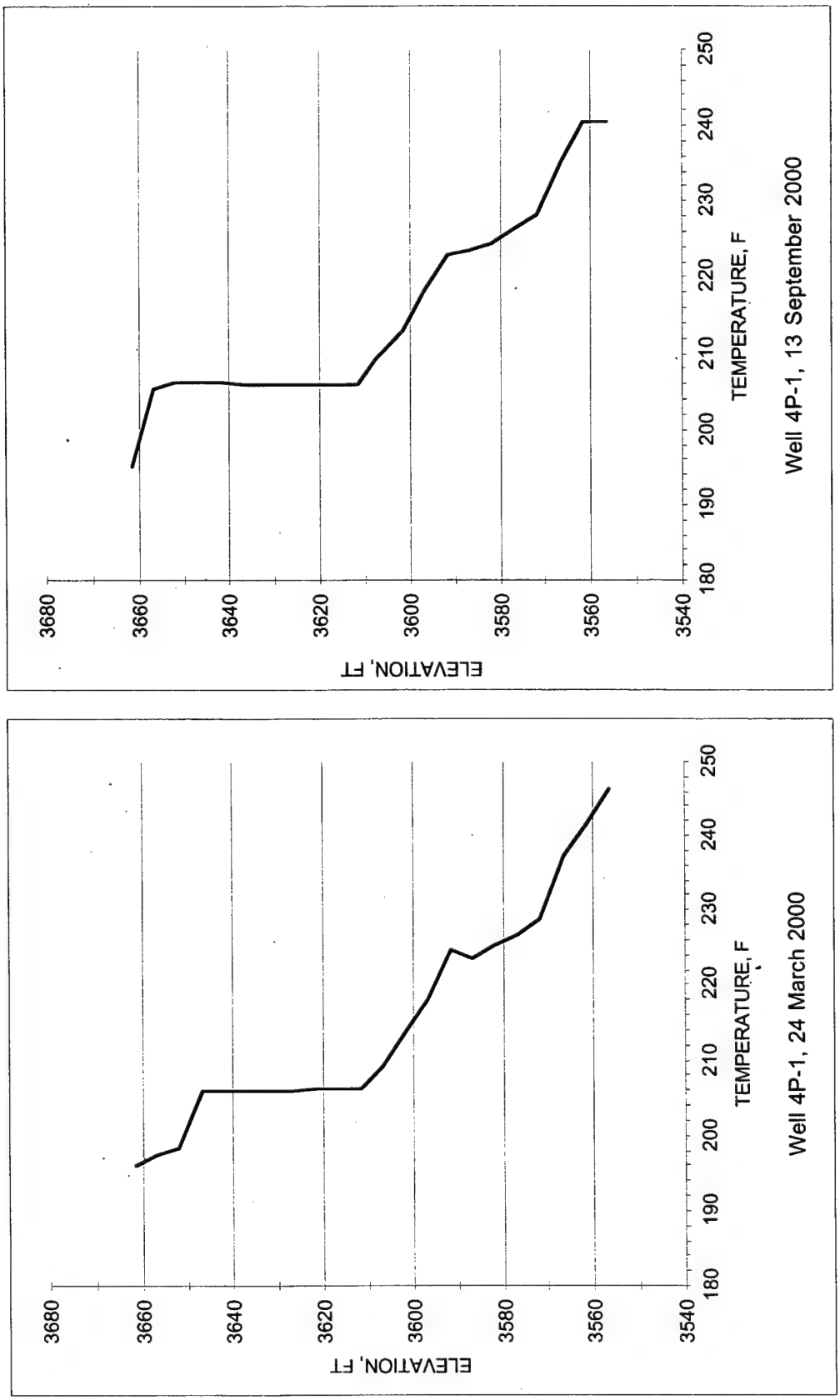


FIGURE 22. (Contd.)

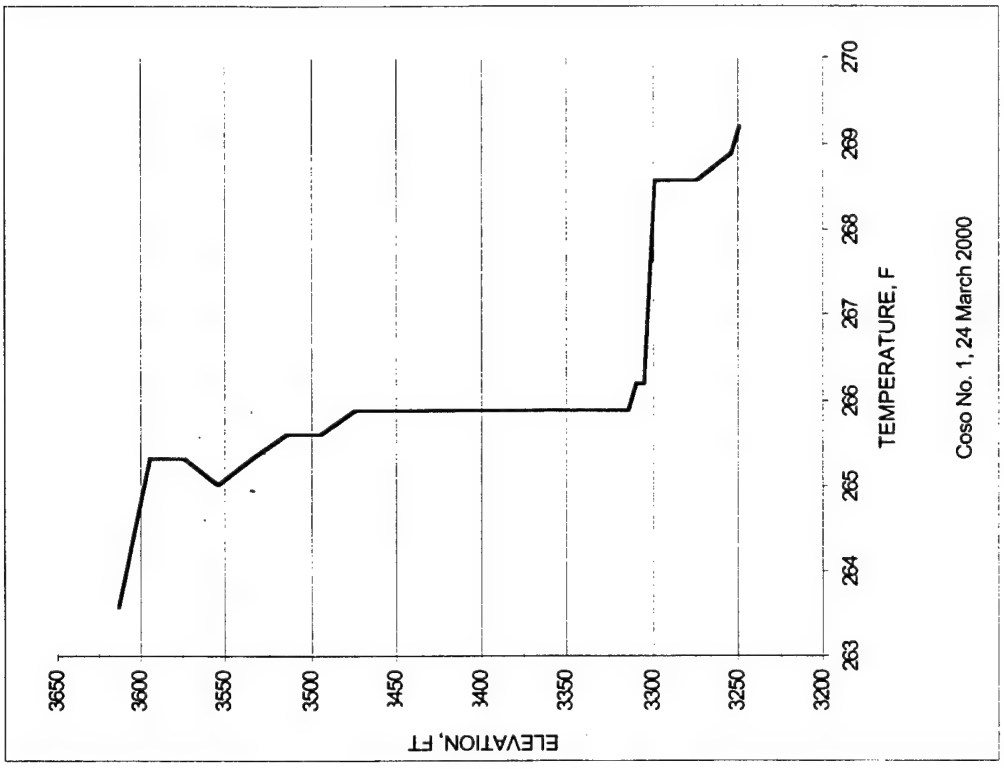


FIGURE 22. (Contd.)

OTHER GEOTHERMAL ACTIVITY AT COSO HOT SPRINGS

WEST CANYONS

The two west canyons are located approximately 0.7 km west of the Coso Resort area (Figure 1), on a course perpendicular to the strike-slip fault that runs north and south through the Coso Hot Springs area. Fluid discharge from the west canyon area is seasonal. In the spring and fall the canyon has more fluid discharge; the canyon dries up during the summer months.

The southerly canyon consists of hydrothermal alteration and scattered thermal activity both in the canyon and for a wide area at the mouth of the canyon. The geology indicates an extensive history of fluctuating thermal activities and features. The prominent area of present activity includes an active steam vent bordering a vigorously boiling pool. At a greater distance up the canyon are two diminutive steam vents, small springs, and fossil hot spring terrace deposits. Thermal activity in these areas is sporadic, depending upon climatic conditions. (Rain station No. 2 is located at the west end of this southerly canyon.)

One of the indicators of newly heated ground is the die-off of vegetation. It appears that the heated ground on the south side of the east-west facing canyon has increased slightly during this reporting period. We will continue to monitor the area during the next reporting period.

The northerly west canyon holds an extensive area of hydrothermal alteration and fossil hot spring deposits. Present thermal activity is limited to warm-to-hot ground with a small number of steam vents. The earth slump, first noted in NAWS-CL TP 001, has shown no visible changes in the past year. Much of the slump area is warm-to-hot, with steam emanating from multiple vents, specifically along the face of the slump. The small pools of mud and steam condensate, noted in last year's summary, are still present to the west of the slump.

DISCUSSION AND SUMMARY

During this reporting period, the central Coso Fault thermal area has changed slightly. The thermal area includes the Coso Corrosion Array, the Coso Resort mudfield, the South Pool, and the smaller pools and pots in between. New thermal manifestation in the Coso Corrosion Array area includes several small mud pots and fumaroles around the existing wells.

The activity in the Coso Corrosion Array mud pots, and increases in the Coso 1 shut-in well pressure and the pressure at the Stove Pipe Eight-Inch Steam Well (4H-4) seem to be correlated since they occurred at the same time period. The activity at the large mud pot in the Coso Corrosion Array has remained very stable during this reporting period with only seasonal increase and decrease in fluids.

The overall activity of the entire Hot Springs has remained nearly stable, with the normal seasonal fluctuations in fluid activity and some slight increases in hot spots as noted in the report.

PLANS FOR FISCAL YEAR 2001

We will continue to monitor, visually and photographically, the hot springs area to document any changes in the area.

REFERENCES

1. Naval Air Weapons Station. Coso Monitoring Program, October 1993 Through September 1994, by S. C. Bjornstad, Public Works Department, J. H. Monahan, J. K. Sprouse and D. M. White, Comarco Weapons Support Division, Ridgecrest, Calif. China Lake, Calif., NAWS-CL, January 1995. 106 pp. (NAWS-CL TP 006, publication UNCLASSIFIED.)

2. ———. Coso Monitoring Program, October 1991 Through September 1992, by J. H. Monahan and K. L. Larson, Comarco Weapons Support Division, Ridgecrest, Calif. China Lake, Calif., NAWS-CL, December 1992. 123 pp. (NAWS-CL TP 001, publication UNCLASSIFIED.)

Appendix

DAILY STEAM FLOW

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
10/01/99	209.89	193.98	10/01/99	829.11	813.46	10/01/99	432.37	400.26
10/02/99	208.90	189.00	10/02/99	829.11	821.28	10/02/99	430.07	424.34
10/03/99	189.00	169.11	10/03/99	829.11	816.59	10/03/99	418.61	417.46
10/04/99	208.90	174.08	10/04/99	813.46	810.33	10/04/99	423.19	416.31
10/05/99	213.87	189.00	10/05/99	813.46	810.33	10/05/99	430.07	422.05
10/06/99	213.87	184.03	10/06/99	829.11	810.33	10/06/99	427.78	418.61
10/07/99	192.98	170.10	10/07/99	813.46	807.20	10/07/99	414.02	409.89
10/08/99	198.95	177.07	10/08/99	813.46	800.95	10/08/99	419.75	412.87
10/09/99	202.93	184.03	10/09/99	813.46	807.20	10/09/99	422.05	417.46
10/10/99	202.93	183.03	10/10/99	816.59	807.20	10/10/99	423.19	418.61
10/11/99	202.93	190.99	10/11/99	813.46	810.33	10/11/99	424.34	418.61
10/12/99	198.95	179.06	10/12/99	813.46	810.33	10/12/99	423.19	412.87
10/13/99	208.90	183.03	10/13/99	813.46	797.82	10/13/99	433.51	420.90
10/14/99	218.85	196.96	10/14/99	813.46	804.08	10/14/99	440.40	433.51
10/15/99	209.89	207.90	10/15/99	816.59	810.33	10/15/99	436.96	434.66
10/16/99	191.99	171.10	10/16/99	800.95	797.82	10/16/99	423.19	412.87
10/17/99	198.95	169.11	10/17/99	797.82	794.69	10/17/99	425.49	420.90
10/18/99	204.92	189.00	10/18/99	800.95	794.69	10/18/99	431.22	425.49
10/19/99	198.95	184.03	10/19/99	800.95	797.82	10/19/99	424.34	419.75
10/20/99	203.92	188.01	10/20/99	797.82	785.30	10/20/99	427.21	421.47
10/21/99	207.90	189.00	10/21/99	800.95	785.30	10/21/99	430.07	423.19
10/22/99	211.88	197.96	10/22/99	810.33	797.82	10/22/99	431.22	426.63
10/23/99	208.90	196.96	10/23/99	810.33	800.95	10/23/99	430.07	424.34
10/24/99	208.90	189.00	10/24/99	800.95	797.82	10/24/99	427.78	424.34
10/25/99	208.40	189.00	10/25/99	797.82	788.43	10/25/99	428.93	423.19
10/26/99	223.82	198.95	10/26/99	797.82	790.00	10/26/99	436.96	427.78
10/27/99	210.89	198.95	10/27/99	782.18	766.53	10/27/99	430.07	424.34
10/28/99	218.85	199.94	10/28/99	810.33	782.18	10/28/99	435.81	426.63
10/29/99	198.95	174.08	10/29/99	829.11	813.46	10/29/99	425.49	412.87

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
10/30/99	203.92	189.00	10/30/99	829.11	807.20	10/30/99	424.34	417.46
10/31/99	212.88	190.00	10/31/99	816.59	797.82	10/31/99	427.78	422.05
11/01/99	208.90	197.96	11/01/99	797.82	782.18	11/01/99	428.93	423.19
11/02/99	214.87	194.97	11/02/99	782.18	766.53	11/02/99	430.07	423.19
11/03/99	211.88	197.96	11/03/99	829.11	800.95	11/03/99	430.07	422.05
11/04/99	218.85	203.92	11/04/99	829.11	816.59	11/04/99	431.22	428.93
11/05/99	202.93	191.99	11/05/99	825.98	816.59	11/05/99	427.78	419.75
11/06/99	208.90	190.00	11/06/99	816.59	810.33	11/06/99	427.78	420.90
11/07/99	223.82	203.92	11/07/99	819.72	813.46	11/07/99	433.51	425.49
11/08/99	214.87	199.94	11/08/99	816.59	813.46	11/08/99	430.07	424.34
11/09/99	213.87	190.00	11/09/99	813.46	800.95	11/09/99	427.78	418.61
11/10/99	218.85	198.95	11/10/99	816.59	800.95	11/10/99	434.66	424.34
11/11/99	202.93	189.00	11/11/99	844.75	797.82	11/11/99	422.05	418.61
11/12/99	207.90	189.00	11/12/99	854.14	841.62	11/12/99	425.49	418.61
11/13/99	211.88	197.96	11/13/99	854.14	829.11	11/13/99	425.49	420.90
11/14/99	216.86	196.96	11/14/99	829.11	813.46	11/14/99	427.78	420.90
11/15/99	217.85	198.95	11/15/99	810.33	794.69	11/15/99	428.93	424.34
11/16/99	227.30	206.91	11/16/99	807.20	794.69	11/16/99	435.81	424.34
11/17/99	218.85	184.03	11/17/99	844.75	816.59	11/17/99	430.07	417.46
11/18/99	198.95	191.99	11/18/99	825.98	816.59	11/18/99	419.75	417.46
11/19/99	211.88	189.00	11/19/99	829.11	822.85	11/19/99	427.78	418.61
11/20/99	220.83	198.95	11/20/99	829.11	822.85	11/20/99	435.81	424.34
11/21/99	225.81	208.90	11/21/99	829.11	825.98	11/21/99	432.94	425.49
11/22/99	206.91	190.00	11/22/99	825.98	813.46	11/22/99	423.19	412.87
11/23/99	204.92	189.00	11/23/99	829.11	816.59	11/23/99	424.34	418.61
11/24/99	239.73	189.00	11/24/99	860.39	822.85	11/24/99	431.22	418.61
11/25/99	225.81	197.96	11/25/99	857.26	822.85	11/25/99	432.94	423.19
11/26/99	230.78	213.87	11/26/99	857.26	844.75	11/26/99	436.96	431.22
11/27/99	219.84	203.92	11/27/99	854.14	847.88	11/27/99	432.37	424.34

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
11/28/99	204.92	188.01	11/28/99	188.01	841.62	11/28/99	418.61	416.31
11/29/99	214.87	190.00	11/29/99	190.00	838.49	11/29/99	424.34	418.61
11/30/99	232.77	207.90	11/30/99	207.90	844.75	11/30/99	432.37	424.34
12/01/99	227.80	208.90	12/01/99	208.90	844.75	12/01/99	424.34	416.31
12/02/99	238.74	202.93	12/02/99	202.93	854.14	12/02/99	441.54	424.34
12/03/99	219.84	199.94	12/03/99	199.94	844.75	12/03/99	424.34	418.61
12/04/99	217.85	198.95	12/04/99	198.95	841.62	12/04/99	423.19	417.46
12/05/99	229.79	213.87	12/05/99	213.87	841.62	12/05/99	430.07	423.19
12/06/99	239.73	218.85	12/06/99	218.85	841.62	12/06/99	434.66	424.34
12/07/99	268.58	237.75	12/07/99	237.75	841.62	12/07/99	447.28	435.81
12/08/99	243.71	218.85	12/08/99	218.85	825.98	12/08/99	424.34	418.61
12/09/99	269.58	274.55	12/09/99	274.55	829.11	12/09/99	441.54	427.78
12/10/99	258.64	238.74	12/10/99	238.74	829.11	12/10/99	435.81	423.19
12/11/99	244.71	226.80	12/11/99	226.80	832.23	12/11/99	424.34	418.61
12/12/99	259.63	232.77	12/12/99	232.77	829.11	12/12/99	430.07	422.05
12/13/99	268.58	258.64	12/13/99	258.64	829.11	12/13/99	441.54	430.07
12/14/99	248.69	228.79	12/14/99	228.79	825.98	12/14/99	423.19	417.46
12/15/99	271.07	245.70	12/15/99	245.70	822.85	12/15/99	428.93	414.02
12/16/99	269.58	249.68	12/16/99	249.68	816.59	12/16/99	432.37	427.21
12/17/99	268.58	253.66	12/17/99	253.66	825.98	12/17/99	430.07	424.34
12/18/99	278.53	262.61	12/18/99	262.61	838.49	12/18/99	440.40	432.37
12/19/99	272.56	256.15	12/19/99	256.15	832.23	12/19/99	430.07	423.19
12/20/99	268.58	248.69	12/20/99	248.69	829.11	12/20/99	430.07	423.19
12/21/99	278.53	263.61	12/21/99	263.61	829.11	12/21/99	435.81	415.74
12/22/99	266.59	259.63	12/22/99	259.63	816.59	12/22/99	430.07	424.34
12/23/99	273.56	249.68	12/23/99	249.68	816.59	12/23/99	425.49	417.46
12/24/99	283.50	258.64	12/24/99	258.64	825.98	12/24/99	426.63	418.61
12/25/99	293.45	274.55	12/25/99	274.55	825.98	12/25/99	432.37	425.49
12/26/99	288.48	270.57	12/26/99	270.57	825.98	12/26/99	424.34	412.87

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
12/27/99	288.48	270.57	12/27/99	825.98	822.85	12/27/99	417.46	411.72
12/28/99	303.40	279.52	12/28/99	832.23	825.98	12/28/99	435.81	424.34
12/29/99	309.37	293.45	12/29/99	832.23	829.11	12/29/99	431.22	424.34
12/30/99	309.37	293.45	12/30/99	832.23	829.11	12/30/99	425.49	418.61
12/31/99	323.29	303.40	12/31/99	841.62	829.11	12/31/99	432.94	428.93
01/01/00	319.31	303.40	01/01/00	832.23	825.98	01/01/00	435.81	428.93
01/02/00	313.35	293.45	01/02/00	844.75	838.49	01/02/00	430.07	424.34
01/03/00	299.42	283.50	01/03/00	844.75	838.49	01/03/00	424.34	418.61
01/04/00	328.27	298.43	01/04/00	857.26	844.75	01/04/00	435.81	424.34
01/05/00	324.29	319.31	01/05/00	858.83	854.14	01/05/00	438.68	430.07
01/06/00	318.32	298.43	01/06/00	858.83	847.88	01/06/00	435.81	428.93
01/07/00	329.26	323.29	01/07/00	860.39	857.26	01/07/00	441.54	434.66
01/08/00	334.24	318.32	01/08/00	863.52	857.26	01/08/00	435.81	433.51
01/09/00	338.22	318.32	01/09/00	860.39	857.26	01/09/00	436.96	424.34
01/10/00	338.22	318.32	01/10/00	876.04	860.39	01/10/00	436.96	428.93
01/11/00	343.19	320.31	01/11/00	876.04	860.39	01/11/00	441.54	428.93
01/12/00	333.24	318.32	01/12/00	891.68	876.04	01/12/00	431.22	424.34
01/13/00	328.27	308.37	01/13/00	907.32	891.68	01/13/00	431.22	424.34
01/14/00	333.24	313.35	01/14/00	907.32	901.07	01/14/00	438.10	431.22
01/15/00	323.29	308.37	01/15/00	907.32	869.78	01/15/00	430.07	424.34
01/16/00	318.32	304.39	01/16/00	860.39	844.75	01/16/00	423.19	418.61
01/17/00	331.25	319.31	01/17/00	851.01	832.23	01/17/00	420.90	412.87
01/18/00	333.24	313.35	01/18/00	869.78	844.75	01/18/00	428.93	419.75
01/19/00	338.22	319.31	01/19/00	876.04	863.52	01/19/00	431.22	427.78
01/20/00	338.22	318.32	01/20/00	891.68	882.29	01/20/00	441.54	433.51
01/21/00	338.22	313.35	01/21/00	897.94	891.68	01/21/00	440.40	433.51
01/22/00	340.20	324.29	01/22/00	876.04	860.39	01/22/00	435.81	428.93
01/23/00	333.24	318.32	01/23/00	860.39	844.75	01/23/00	424.34	420.90
01/24/00	336.23	318.32	01/24/00	854.14	829.11	01/24/00	424.34	418.61

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
01/25/00	335.23	330.75	01/25/00	860.39	844.75	01/25/00	428.93	422.05
01/26/00	324.29	315.34	01/26/00	876.04	863.52	01/26/00	424.34	418.61
01/27/00	332.25	308.37	01/27/00	876.04	869.78	01/27/00	425.49	418.61
01/28/00	333.24	314.34	01/28/00	876.04	866.65	01/28/00	427.78	418.61
01/29/00	338.22	296.44	01/29/00	876.04	872.91	01/29/00	433.51	424.34
01/30/00	337.22	323.29	01/30/00	876.04	872.91	01/30/00	431.22	424.34
01/31/00	333.24	322.30	01/31/00	876.04	872.91	01/31/00	425.49	418.61
02/01/00	332.25	313.35	02/01/00	876.04	860.39	02/01/00	418.61	414.02
02/02/00	347.17	330.26	02/02/00	888.55	876.04	02/02/00	430.07	427.78
02/03/00	349.16	328.27	02/03/00	879.16	876.04	02/03/00	436.96	428.93
02/04/00	343.19	325.28	02/04/00	879.16	876.04	02/04/00	430.07	427.21
02/05/00	343.19	322.30	02/05/00	877.60	874.47	02/05/00	427.78	423.19
02/06/00	337.22	313.35	02/06/00	876.04	869.78	02/06/00	419.75	412.87
02/07/00	347.17	313.35	02/07/00	876.04	866.65	02/07/00	423.19	416.31
02/08/00	353.14	327.27	02/08/00	879.16	876.04	02/08/00	439.25	424.34
02/09/00	353.14	332.25	02/09/00	922.97	907.32	02/09/00	441.54	428.93
02/10/00	350.65	329.26	02/10/00	907.32	891.68	02/10/00	446.70	436.96
02/11/00	343.19	318.32	02/11/00	891.68	876.04	02/11/00	441.54	430.07
02/12/00	343.19	328.27	02/12/00	860.39	844.75	02/12/00	439.25	423.19
02/13/00	345.68	325.78	02/13/00	857.26	844.75	02/13/00	427.78	418.61
02/14/00	343.19	315.83	02/14/00	876.04	857.26	02/14/00	420.90	407.14
02/15/00	340.20	317.33	02/15/00	894.81	879.16	02/15/00	418.61	407.14
02/16/00	353.63	337.22	02/16/00	891.68	876.04	02/16/00	440.40	434.66
02/17/00	335.23	326.28	02/17/00	891.68	882.29	02/17/00	430.07	418.61
02/18/00	338.22	314.34	02/18/00	876.04	866.65	02/18/00	422.05	414.02
02/19/00	348.16	326.28	02/19/00	863.52	860.39	02/19/00	429.50	418.61
02/20/00	353.14	348.16	02/20/00	860.39	857.26	02/20/00	435.81	429.50
02/21/00	353.14	346.17	02/21/00	863.52	857.26	02/21/00	430.07	425.49
02/22/00			02/22/00	876.04	869.78	02/22/00	430.07	420.90

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
02/23/00	378.01	368.06	02/23/00	891.68	876.04	02/23/00		
02/24/00	368.06	355.62	02/24/00	876.04	872.91	02/24/00		
02/25/00	358.11	346.17	02/25/00	876.04	872.91	02/25/00		
02/26/00	363.08	348.16	02/26/00	876.04	866.65	02/26/00		
02/27/00	363.08	352.14	02/27/00	891.68	876.04	02/27/00		
02/28/00	338.22	322.30	02/28/00	901.07	891.68	02/28/00		
02/29/00	338.22	329.26	02/29/00	907.32	891.68	02/29/00		
03/01/00	333.24	318.32	03/01/00	904.19	891.68	03/01/00		
03/02/00	338.22	313.35	03/02/00	891.68	888.55	03/02/00		
03/03/00	335.73	318.32	03/03/00	891.68	888.55	03/03/00		
03/04/00	354.13	323.29	03/04/00	894.81	891.68	03/04/00		
03/05/00	343.19	340.70	03/05/00	901.07	888.55	03/05/00		
03/06/00	344.18	330.75	03/06/00	901.07	891.68	03/06/00		
03/07/00			03/07/00	897.94	894.81	03/07/00		
03/08/00			03/08/00	894.81	891.68	03/08/00		
03/09/00			03/09/00	904.19	897.94	03/09/00		
03/10/00			03/10/00	904.19	894.81	03/10/00		
03/11/00			03/11/00	910.45	904.19	03/11/00		
03/12/00			03/12/00	907.32	901.07	03/12/00		
03/13/00			03/13/00	907.32	897.94	03/13/00		
03/14/00	283.50	266.10	03/14/00	922.97	910.45	03/14/00	435.81	418.61
03/15/00	291.46	248.69	03/15/00	919.84	907.32	03/15/00	435.81	424.34
03/16/00	265.60	233.77	03/16/00	913.58	897.94	03/16/00	428.93	412.87
03/17/00	243.71	218.85	03/17/00	907.32	901.07	03/17/00	428.93	419.75
03/18/00	257.64	218.85	03/18/00	922.97	916.71	03/18/00	453.01	435.81
03/19/00	289.47	238.74	03/19/00	916.71	894.81	03/19/00	430.07	418.61
03/20/00	263.61	225.81	03/20/00	919.84	901.07	03/20/00	428.93	418.61
03/21/00	233.77	219.84	03/21/00	922.97	901.07	03/21/00	430.07	418.61
03/22/00	248.69	234.76	03/22/00	919.84	916.71	03/22/00	432.94	424.34
03/23/00	249.68	228.79	03/23/00	919.84	907.32	03/23/00	430.07	425.49

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
03/24/00	253.66	233.77	03/24/00	922.97	907.32	03/24/00	428.93	424.34
03/25/00	254.66	233.77	03/25/00	919.84	910.45	03/25/00	426.63	419.75
03/26/00	263.61	228.79	03/26/00	916.71	907.32	03/26/00	427.78	418.61
03/27/00	278.53	247.69	03/27/00	922.97	910.45	03/27/00	447.28	431.22
03/28/00	268.58	253.66	03/28/00	935.48	922.97	03/28/00	440.40	434.66
03/29/00	254.66	243.71	03/29/00	935.48	922.97	03/29/00	430.07	427.78
03/30/00	253.66	238.74	03/30/00	922.97	907.32	03/30/00	426.63	417.46
03/31/00	258.64	237.75	03/31/00	922.97	910.45	03/31/00	425.49	416.31
04/01/00	268.58	238.74	04/01/00	922.97	913.58	04/01/00	425.49	416.31
04/02/00	283.50	246.20	04/02/00	922.97	907.32	04/02/00	424.34	412.87
04/03/00	267.59	228.79	04/03/00	922.97	910.45	04/03/00	418.61	411.72
04/04/00	297.43	238.74	04/04/00	922.97	916.71	04/04/00	435.81	419.75
04/05/00	283.50	251.67	04/05/00	922.97	919.84	04/05/00	389.93	386.49
04/06/00	258.64	233.77	04/06/00	916.71	907.32	04/06/00	407.14	401.40
04/07/00	273.56	258.64	04/07/00	926.10	922.97	04/07/00	408.28	401.40
04/08/00	272.56	228.79	04/08/00	954.25	938.61	04/08/00	416.31	408.28
04/09/00	274.55	241.72	04/09/00	966.77	954.25	04/09/00	410.58	402.55
04/10/00	278.53	249.68	04/10/00	957.38	951.12	04/10/00	395.67	389.93
04/11/00	258.64	238.74	04/11/00	938.61	922.97	04/11/00	389.93	383.05
04/12/00	274.55	238.74	04/12/00	922.97	910.45	04/12/00	410.00	396.81
04/13/00	273.56	237.75	04/13/00	926.10	919.84	04/13/00	417.46	408.28
04/14/00	275.55	250.68	04/14/00	926.10	922.97	04/14/00	416.31	409.43
04/15/00	274.55	258.64	04/15/00	929.22	922.97	04/15/00	401.40	394.52
04/16/00	268.58	244.71	04/16/00	926.10	922.97	04/16/00	392.23	384.20
04/17/00	268.58	238.74	04/17/00	932.35	922.97	04/17/00	401.40	393.37
04/18/00	268.58	252.67	04/18/00	926.10	922.97	04/18/00	401.40	393.37
04/19/00	263.61	243.71	04/19/00	938.61	922.97	04/19/00	400.26	394.52
04/20/00	263.61	238.74	04/20/00	929.22	910.45	04/20/00	414.02	402.55
04/21/00	278.53	246.70	04/21/00	932.35	919.84	04/21/00	420.90	417.46

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
04/22/00	293.45	263.61	04/22/00	926.10	922.97	04/22/00	407.14	401.40
04/23/00	283.50	252.67	04/23/00	929.22	922.97	04/23/00	395.67	389.93
04/24/00	283.50	250.68	04/24/00	935.48	922.97	04/24/00	388.79	378.47
04/25/00	278.53	246.70	04/25/00	938.61	922.97	04/25/00	395.67	387.64
04/26/00	288.48	249.68	04/26/00	938.61	929.22	04/26/00	407.14	401.40
04/27/00	292.46	254.66	04/27/00	948.00	935.48	04/27/00	417.46	403.70
04/28/00	293.45	253.66	04/28/00	948.00	938.61	04/28/00	412.87	407.14
04/29/00	288.48	263.61	04/29/00	926.10	919.84	04/29/00	397.96	384.20
04/30/00	262.61	237.75	04/30/00	922.97	910.45	04/30/00	399.11	389.93
05/01/00	267.59	233.77	05/01/00	938.61	922.97	05/01/00	409.43	400.26
05/02/00	283.50	248.69	05/02/00	938.61	926.10	05/02/00	410.58	405.99
05/03/00	293.45	258.64	05/03/00	938.61	932.35	05/03/00	411.72	408.28
05/04/00	288.48	266.10	05/04/00	941.74	932.35	05/04/00	412.87	405.99
05/05/00	297.43	248.69	05/05/00	941.74	932.35	05/05/00	411.72	405.99
05/06/00	279.52	253.66	05/06/00	938.61	929.22	05/06/00	407.14	401.40
05/07/00	273.56	247.69	05/07/00	938.61	926.10	05/07/00	404.84	401.40
05/08/00	273.56	248.69	05/08/00	938.61	926.10	05/08/00	401.40	400.26
05/09/00	263.61	248.69	05/09/00	944.87	922.97	05/09/00	412.87	401.40
05/10/00	298.43	248.69	05/10/00	938.61	922.97	05/10/00	399.11	389.93
05/11/00	254.66	252.67	05/11/00	922.97	907.32	05/11/00	401.40	384.20
05/12/00	261.12	228.79	05/12/00	929.22	922.97	05/12/00	424.91	397.96
05/13/00	271.57	248.69	05/13/00	938.61	935.48	05/13/00	403.70	395.67
05/14/00	267.59	252.67	05/14/00	938.61	935.48	05/14/00	411.72	403.70
05/15/00	274.55	252.67	05/15/00	941.74	935.48	05/15/00	405.99	400.26
05/16/00	273.56	257.64	05/16/00	938.61	935.48	05/16/00	401.40	399.11
05/17/00	268.58	248.69	05/17/00	938.61	935.48	05/17/00	400.26	389.93
05/18/00	268.58	238.74	05/18/00	938.61	932.35	05/18/00	403.70	394.52
05/19/00	286.49	248.69	05/19/00	938.61	935.48	05/19/00	405.99	399.11
05/20/00	293.45	253.66	05/20/00	954.25	938.61	05/20/00	407.14	401.40

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
05/21/00	303.40	243.71	05/21/00	954.25	941.74	05/21/00	407.14	401.40
05/22/00	295.44	253.66	05/22/00	954.25	941.74	05/22/00	407.14	404.84
05/23/00	298.43	248.69	05/23/00	957.38	952.69	05/23/00	414.02	407.14
05/24/00	308.37	254.66	05/24/00	957.38	954.25	05/24/00	418.61	411.72
05/25/00	288.48	258.64	05/25/00	966.77	954.25	05/25/00	405.99	402.55
05/26/00	258.64	248.19	05/26/00	957.38	954.25	05/26/00	405.99	400.26
05/27/00	263.61	237.75	05/27/00	954.25	951.12	05/27/00	407.71	401.40
05/28/00	288.48	242.72	05/28/00	960.51	954.25	05/28/00	407.14	405.99
05/29/00	274.55	249.68	05/29/00	969.90	954.25	05/29/00	408.28	405.99
05/30/00	274.55	253.66	05/30/00	969.90	963.64	05/30/00	409.43	406.56
05/31/00	261.62	238.74	05/31/00	966.77	963.64	05/31/00	407.71	403.70
06/01/00	258.64	233.77	06/01/00	969.90	957.38	06/01/00	403.12	401.40
06/02/00	253.66	231.78	06/02/00	969.90	957.38	06/02/00	401.40	398.54
06/03/00	257.64	238.74	06/03/00	969.90	960.51	06/03/00	401.40	399.11
06/04/00	263.61	245.70	06/04/00	969.90	960.51	06/04/00	407.14	400.83
06/05/00	263.61	239.73	06/05/00	969.90	960.51	06/05/00	407.14	403.70
06/06/00	266.10	238.74	06/06/00	973.03	957.38	06/06/00	406.56	402.55
06/07/00	273.56	253.66	06/07/00	979.28	968.33	06/07/00	412.87	404.27
06/08/00	263.61	237.75	06/08/00	976.15	957.38	06/08/00	420.90	412.87
06/09/00	263.61	230.78	06/09/00	969.90	954.25	06/09/00	423.19	417.46
06/10/00	269.58	238.24	06/10/00	966.77	954.25	06/10/00	420.90	417.46
06/11/00			06/11/00	963.64	954.25	06/11/00	417.46	412.87
06/12/00			06/12/00	966.77	954.25	06/12/00	416.31	412.87
06/13/00			06/13/00	966.77	954.25	06/13/00	417.46	412.87
06/14/00	288.48	238.74	06/14/00	969.90	957.38	06/14/00	422.05	419.75
06/15/00	283.50	258.64	06/15/00	963.64	951.12	06/15/00	431.22	423.19
06/16/00	273.56	248.69	06/16/00	985.54	969.90	06/16/00	431.22	425.49
06/17/00	263.61	238.74	06/17/00	985.54	982.41	06/17/00	424.34	422.05
06/18/00	258.64	228.79	06/18/00	982.41	973.03	06/18/00	426.63	418.61

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
06/19/00	258.64	227.80	06/19/00	979.28	969.90	06/19/00	424.34	420.90
06/20/00	253.66	228.79	06/20/00	979.28	969.90	06/20/00	422.05	418.61
06/21/00	263.61	236.75	06/21/00	973.03	966.77	06/21/00	424.34	419.75
06/22/00	258.64	238.74	06/22/00	973.03	969.90	06/22/00	426.06	423.19
06/23/00	253.66	228.79	06/23/00	973.03	966.77	06/23/00	424.34	420.90
06/24/00	236.75	207.90	06/24/00	969.90	963.64	06/24/00	420.90	417.46
06/25/00	233.77	203.92	06/25/00	969.90	963.64	06/25/00	424.34	418.61
06/26/00	232.77	202.93	06/26/00	973.03	966.77	06/26/00	425.49	420.90
06/27/00	237.75	190.99	06/27/00	973.03	966.77	06/27/00	424.34	421.47
06/28/00	217.85	189.00	06/28/00	969.90	957.38	06/28/00	423.19	418.61
06/29/00	227.80	230.78	06/29/00	969.90	957.38	06/29/00	424.34	418.61
06/30/00	208.90	228.79	06/30/00	969.90	957.38	06/30/00	424.34	418.61
07/01/00	202.93	172.09	07/01/00	966.77	957.38	07/01/00	425.49	418.61
07/02/00	198.95	166.12	07/02/00	966.77	957.38	07/02/00	424.34	418.61
07/03/00	189.00	161.15	07/03/00	966.77	957.38	07/03/00	423.19	418.61
07/04/00	189.00	152.20	07/04/00	969.90	957.38	07/04/00	420.90	417.46
07/05/00	189.00	158.17	07/05/00	969.90	954.25	07/05/00	425.49	423.19
07/06/00	187.01	150.21	07/06/00	969.90	957.38	07/06/00	428.93	420.90
07/07/00	187.01	149.21	07/07/00	969.90	960.51	07/07/00	429.50	423.19
07/08/00	179.06	148.22	07/08/00	966.77	960.51	07/08/00	427.78	422.05
07/09/00	180.05	149.21	07/09/00	966.77	957.38	07/09/00	427.78	420.90
07/10/00	169.11	149.21	07/10/00	969.90	957.38	07/10/00	427.78	423.19
07/11/00	174.08	149.21	07/11/00	969.90	960.51	07/11/00	425.49	422.05
07/12/00	179.06	153.19	07/12/00	963.64	954.25	07/12/00	424.34	418.61
07/13/00	242.72	172.59	07/13/00	969.90	960.51	07/13/00	429.50	424.34
07/14/00	248.69	149.21	07/14/00	969.90	960.51	07/14/00	429.50	424.34
07/15/00	248.69	152.20	07/15/00	969.90	954.25	07/15/00	424.34	419.75
07/16/00	247.69	154.19	07/16/00	969.90	963.64	07/16/00	416.31	412.87
07/17/00	248.69	164.13	07/17/00	969.90	963.64	07/17/00	411.72	407.14

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
07/18/00	253.66	159.16	07/18/00	966.77	957.38	07/18/00	414.02	408.28
07/19/00	220.83	179.06	07/19/00	966.77	954.25	07/19/00	424.34	418.61
07/20/00	189.00	149.21	07/20/00	969.90	957.38	07/20/00	427.78	424.34
07/21/00	208.90	169.11	07/21/00	966.77	960.51	07/21/00	428.93	424.34
07/22/00	230.78	159.16	07/22/00	966.77	957.38	07/22/00	424.34	419.75
07/23/00	197.96	166.12	07/23/00	954.25	951.12	07/23/00	418.61	412.87
07/24/00	190.00	159.16	07/24/00	954.25	944.87	07/24/00	411.72	407.14
07/25/00	208.90	159.16	07/25/00	954.25	948.00	07/25/00	416.31	408.28
07/26/00	230.78	193.98	07/26/00	960.51	944.87	07/26/00	424.34	412.87
07/27/00	230.78	151.20	07/27/00	955.82	951.12	07/27/00	418.61	412.87
07/28/00	240.73	158.17	07/28/00	954.25	951.12	07/28/00	418.61	417.46
07/29/00	253.66	158.66	07/29/00	954.25	951.12	07/29/00	419.75	418.61
07/30/00	268.58	159.16	07/30/00	954.25	944.87	07/30/00	419.75	417.46
07/31/00	242.72	149.21	07/31/00	954.25	948.00	07/31/00	417.46	412.87
08/01/00	248.69	152.20	08/01/00	954.25	951.12	08/01/00	418.61	412.87
08/02/00	253.66	149.21	08/02/00	944.87	937.05	08/02/00	418.61	414.02
08/03/00			08/03/00	944.87	937.05	08/03/00	430.07	424.34
08/04/00			08/04/00	941.74	938.61	08/04/00	428.93	424.34
08/05/00			08/05/00	940.17	937.05	08/05/00	424.34	422.05
08/06/00			08/06/00	940.17	937.05	08/06/00	426.63	423.19
08/07/00			08/07/00	941.74	937.05	08/07/00	430.07	424.91
08/08/00			08/08/00	938.61	935.48	08/08/00	429.50	424.34
08/09/00	203.92	149.21	08/09/00	938.61	935.48	08/09/00	426.63	423.19
08/10/00	202.93	158.17	08/10/00	938.61	935.48	08/10/00	429.50	424.34
08/11/00	194.97	149.21	08/11/00	938.61	935.48	08/11/00	425.49	424.34
08/12/00	218.85	152.20	08/12/00	938.61	927.66	08/12/00	427.78	423.77
08/13/00	227.80	159.16	08/13/00	938.61	929.22	08/13/00	429.50	423.77
08/14/00	223.82	151.20	08/14/00	938.61	932.35	08/14/00	425.49	422.62
08/15/00	231.78	149.21	08/15/00	938.61	935.48	08/15/00	423.19	418.61

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
08/16/00	228.79	149.21	08/16/00	938.61	935.48	08/16/00	425.49	423.19
08/17/00	237.75	159.16	08/17/00	938.61	935.48	08/17/00	430.07	424.34
08/18/00	227.80	159.16	08/18/00	938.61	935.48	08/18/00	428.93	425.49
08/19/00	189.00	149.21	08/19/00	938.61	935.48	08/19/00	425.49	423.77
08/20/00	198.45	149.21	08/20/00	938.61	932.35	08/20/00	428.93	424.34
08/21/00	189.00	159.16	08/21/00	938.61	932.35	08/21/00	426.63	424.34
08/22/00	209.89	153.19	08/22/00	938.61	932.35	08/22/00	425.49	422.05
08/23/00	179.06	147.22	08/23/00	935.48	926.10	08/23/00	423.19	417.46
08/24/00			08/24/00	932.35	922.97	08/24/00	424.34	420.90
08/25/00			08/25/00	932.35	922.97	08/25/00	429.50	420.90
08/26/00			08/26/00	932.35	922.97	08/26/00	431.22	424.34
08/27/00			08/27/00	935.48	926.10	08/27/00	430.07	426.63
08/28/00			08/28/00	932.35	926.10	08/28/00	427.78	418.61
08/29/00			08/29/00	922.97	919.84	08/29/00	431.22	423.19
08/30/00			08/30/00	922.97	919.84	08/30/00	430.07	426.63
08/31/00			08/31/00	926.10	919.84	08/31/00	428.93	423.77
09/01/00			09/01/00	926.10	922.97	09/01/00	429.50	425.49
09/02/00			09/02/00	922.97	919.84	09/02/00	428.93	423.19
09/03/00			09/03/00	922.97	919.84	09/03/00	429.50	423.77
09/04/00			09/04/00	922.97	919.84	09/04/00	428.93	423.19
09/05/00			09/05/00	922.97	919.84	09/05/00	424.34	420.90
09/06/00			09/06/00	919.84	913.58	09/06/00	430.07	422.05
09/07/00			09/07/00	922.97	916.71	09/07/00	433.51	426.63
09/08/00			09/08/00	926.10	922.97	09/08/00	427.78	424.34
09/09/00			09/09/00	922.97	919.84	09/09/00	424.34	419.75
09/10/00			09/10/00	919.84	916.71	09/10/00	423.19	418.61
09/11/00			09/11/00	916.71	910.45	09/11/00	424.34	419.75
09/12/00			09/12/00	913.58	907.32	09/12/00	425.49	420.90
09/13/00			09/13/00	922.97	916.71	09/13/00	425.49	424.34

Well 4H4 Flow in pounds per hour (pph)			Schobers Resort Flow in pounds per hour (pph)			Devils Kitchen Flow in pounds per hour (pph)		
Date	High	Low	Date	High	Low	Date	High	Low
09/14/00			09/14/00	425.49	420.90	09/14/00	425.49	420.90
09/15/00			09/15/00	425.49	423.19	09/15/00	425.49	423.19
09/16/00			09/16/00	425.49	422.05	09/16/00	425.49	422.05
09/17/00			09/17/00	426.63	420.90	09/17/00	426.63	420.90
09/18/00			09/18/00	423.19	417.46	09/18/00	423.19	417.46
09/19/00			09/19/00	431.22	418.61	09/19/00	431.22	418.61
09/20/00			09/20/00	432.37	418.61	09/20/00	432.37	418.61
09/21/00			09/21/00	444.98	436.96	09/21/00	444.98	436.96
09/22/00			09/22/00	440.40	435.81	09/22/00	440.40	435.81
09/23/00			09/23/00	423.19	412.87	09/23/00	423.19	412.87
09/24/00			09/24/00	409.43	405.99	09/24/00	409.43	405.99
09/25/00			09/25/00	415.16	407.14	09/25/00	415.16	407.14
09/26/00			09/26/00	418.61	414.02	09/26/00	418.61	414.02
09/27/00	238.74	160.15	09/27/00	423.19	419.75	09/27/00	423.19	419.75
09/28/00	248.69	154.19	09/28/00	426.63	419.75	09/28/00	426.63	419.75
09/29/00	246.70	166.12	09/29/00	426.63	419.75	09/29/00	426.63	419.75
09/30/00	268.58	196.96	09/30/00	423.19	418.61	09/30/00	423.19	418.61

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